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With METALLURGICAL SUPPLEMENT.

The Engineer.

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VOL. CLIV.—No. 3994] LONDON: FRIDAY EVENING, JULY 29, 1932 [PRICE {WITH SUPPLEMENT} ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES.

HEATING.

The Commissioners of His Majesty's Works, &c., are prepared to receive TENDERS before 11 a.m. on Friday, 12th August, 1932, for ACCELERATED LOW-PRESSURE HOT WATER HEATING at the Sorting Office, Worcester.

Drawings, specification, a copy of the conditions and form of contract, bills of quantities, and forms for Tender may be obtained from the CONTRACTS BRANCH, H.M. Office of Works, King Charles-street, London, S.W. 1, on payment of One Pound. (Cheques payable to the Commissioners, H.M. Office of Works.) The sums so paid will be returned to those persons who send in Tenders in conformity with the conditions. 8809

Air Ministry.

DIRECTORATE OF SCIENTIFIC RESEARCH.

APPLICATIONS are INVITED to fill VACANCIES in the Scientific Research Pool for :—

JUNIOR SCIENTIFIC OFFICERS.

The standard aimed at is a First or Second Class Honours Degree or its equivalent in Natural Sciences (if including Physics) or Engineering. Preference will be given to those with some experience of experimental investigation. Ability to read technical French and German is desirable. Candidates should preferably be medically fit for flying duties.

The officers appointed will be required in the first instance to serve at the Royal Aircraft Establishment, Farnborough, Hants.

The salary for these posts is £175 plus Civil Service bonus per annum, giving a present total remuneration of £240 per annum on the scale £175-£15-£235.

The appointments carry superannuation under the Federated Universities Superannuation Scheme, the Government contribution being 10 per cent. of the mean of the salary scale; individual contributions 5 per cent.

Application should be made on a form to be obtained from the CHIEF SUPERINTENDENT, Royal Aircraft Establishment, South Farnborough, Hants, to whom it should be returned not later than 18th August, 1932. 8808

Government of Ceylon.

APPLICATIONS are INVITED for the POST of ASSISTANT ENGINEER, Harbour Engineer's Department, COLOMBO PORT COMMISSION, CEYLON.

Candidates must be British subjects and not over 40 years of age (on 1st May, 1932). They should be fully qualified Chartered Civil Engineers, possessing a knowledge of and having experience in the general routine work of a harbour engineer's office, marine surveying and sounding, design, setting out and construction of various harbour works, including quays, jetties, warehouses, railways, roads, drainage and water supply, dredging and subaqueous rock removal, and laying of moorings; dress diving experience desirable.

Salary £600 to £960 per annum by annual increments of £30.

(For the purpose of payment of salary in the island the £ sterling is calculated at Rs. 15, but this rate is liable to alteration.)

(This scale is at present subject to a levy of 10 per cent.) The post is pensionable.

Government quarters provided if available, rent being charged on the basis of a percentage of salary. Present rate 10 per cent. If Government quarters not available, a rent allowance is paid in accordance with regulations. The rent allowance applicable to this appointment at present is Rs. 112.50 per mensem (if married) or Rs. 56/25 per mensem (if unmarried).

Free outward passages to Ceylon will be provided for the selected candidate and his family (not exceeding five full passages in all). Leave out of the island together with free passages is grantable under the present regulations after each four-year period of resident service.

The appointment is subject to a probationary period of two years, at the end of which the person engaged will be confirmed in the appointment provided he has acquired a knowledge of Tamil and passes a viva voce examination in that language and his services in other respects are considered to be satisfactory. If not confirmed, his services are liable to discontinuance.

Applications, bearing the following reference, i.e., M/2928, should reach the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, London, S.W. 1, on or before the 8th of August. 8806

University College of South WALES AND MONMOUTHSHIRE.

COLEG PRIFATHROFAOL DEHEUDIR CYMRU A MYNWY.

The Council of the College invites APPLICATIONS for the APPOINTMENT of ASSISTANT LECTURER and DEMONSTRATOR in CIVIL ENGINEERING. The commencing salary will be £300 per annum.

Further particulars may be obtained from the undersigned, by whom three copies of application and testimonials must be received on or before August 8th, 1932.

D. J. A. BROWN, Registrar.

University College, Cardiff, July 19th, 1932. 8799

PUBLIC WORKS, ROADS AND TRANSPORT CONGRESS, 1933.

PAPERS COMPETITION.

THE Congress Organising Committee have decided to OFFER the following PRIZES for PAPERS SUBMITTED for DISCUSSION at the 1933 Congress :—

1st Prize—Gold Medal and One Hundred Guineas ;
2nd Prize—Silver Medal and Fifty Guineas ;
3rd Prize—Bronze Medal and Twenty Guineas ;
4th Prize—Ten Guineas ;

with a Prize of Five Guineas for each Paper (excluding those for which the principal prizes are awarded) as selected for discussion.

Papers must be submitted not later than the 31st December, 1932.

Application for the rules and particulars for the Competition must be made to the HON. SECRETARY, Public Works, Roads, and Transport Congress, 84, Eccleston-square, London, S.W. 1.

Papers may be submitted for discussion without being entered for competition. Such papers should be clearly marked "Not for competition." 8798

The Engineer

PRINCIPAL CONTENTS OF THIS ISSUE.
ARRANGED FOR CARD INDEXING.

The Metallurgist.
THE ENGINEER, 29 - 7 - 32.

Coke Oven and By-product Plant at Scunthorpe—No. II. (P. 103)
THE ENGINEER, 29 - 7 - 32.

Economics of Urban Electric Railways No. II. (P. 102)
(HENRY WATSON.) THE ENGINEER, 29 - 7 - 32.

Stresses in Arches with Fixed Ends. (P. 104)
(J. D. W. BALL.) THE ENGINEER, 29 - 7 - 32.

Foreign Engineers in Soviet Russia. (P. 106)
THE ENGINEER, 29 - 7 - 32.

The Composition of Mathematical Writings. (P. 113.)
THE ENGINEER, 29 - 7 - 32.

Steam Engine Trials—Ancient and Modern. (P. 113)
THE ENGINEER, 29 - 7 - 32.

Air Transportation of Gold Dredges. (P. 107)
(CHARLES A. BANKS.) THE ENGINEER, 29 - 7 - 32.

Railway Accidents in 1931. (P. 114)
THE ENGINEER, 29 - 7 - 32.

INDEX TO ADVERTISEMENTS, PAGE 47.

PUBLIC NOTICES.

County Borough of Southend-on-Sea.

PIER AND FORESHORE DEPARTMENT.
TO HEATING ENGINEERS.

TENDERS are INVITED for the SUPPLY and INSTALLATION of a complete and efficient HEATING APPARATUS in the PAVILION on Southend Pier, utilising either coal, gas, oil, or electricity.

The apparatus when installed must be capable of heating and maintaining an interior temperature of 60 deg., with outside temperature at 32 deg.

Tenders must reach me in sealed envelopes not later than 10 a.m. on August 22nd, and must be accompanied by a detailed specification and plan, together with information as to time required for completion of work from date order is placed.

The Pavilion may be inspected between performances, by arrangement with the undersigned, from whom any further information required can be obtained.

The Corporation do not bind themselves to accept the lowest or any Tender.

J. C. JOHNSON, Piermaster.

Pier Office, Pier-hill Building, Southend-on-Sea, 20th June, 1932. 8802

The Portsmouth Water Company.

An ENGINEERING ASSISTANT is REQUIRED by the above Company. Candidates should be about 25 years of age and have passed the Associate Membership Examination of the Institution of Civil Engineers (including Hydraulics) or other exempting Examination. Full training (both theoretical and practical) and subsequent first-class experience in waterworks design and construction essential. Knowledge of pumping machinery would also be advantageous. Commencing salary £350 per annum, rising by annual increments of £25 to £450, less 5 per cent. contribution to Superannuation Fund. The appointment is subject to satisfactory medical examination.

Application should be made only on forms which may be obtained from the ENGINEER, Water Company's Offices, 26, Commercial-road, Portsmouth, and must be delivered at that address not later than Monday, August 22nd next. 8797

PUBLIC NOTICES.

County Borough of Swansea.

ELECTRICITY DEPARTMENT.

STEAM-RAISING PLANT for POWER STATION at Tir John North, comprising Four Water-tube Boilers, each for an evaporation of 240,000 lb. per hour, with Pulverised Fuel Equipment, Dust Arresters, Draught Plant, Chimneys, &c.

The Corporation invite TENDERS for the SUPPLY, DELIVERY, and ERECTION of the above and other INCIDENTAL WORKS.

The works are unemployment relief works and will be subject to conditions laid down by the Government Unemployment Grants Committee.

On and after 30th July, 1932, plans may be seen and general conditions, specification, and form of Tender, in duplicate, obtained at the office of the Consulting Engineers, Messrs. Preece, Cardew and Rider, 8, Queen Anne's-gate, Westminster, S.W. 1, on deposit of Five Guineas, which will be returned on receipt of a bona fide Tender (not subsequently withdrawn).

Additional copies may be obtained on receipt of a fee of £1 1s. for each copy, which will not be returnable.

Sealed Tenders must be received by the undersigned not later than Twelve Noon on the 8th September, 1932.

The lowest or any Tender will not necessarily be accepted.

H. L. LANG-COATH, Town Clerk.

The Guildhall, Swansea, 27th July, 1932. 8803

The Civil Engineers Appointments Board, 8, Princes-street, Westminster, S.W. 1, acting under annual licence from the London County Council, invites INQUIRIES from EMPLOYERS SEEKING the SERVICES of PROFESSIONAL ENGINEERS, either as Assistants or in more responsible positions.

All those whose names are accepted for entry in the Board's Register for employment possess qualifications which have been attested by means of scientific examinations, practical training, and experience. P2183

PUBLIC NOTICES

West Cheshire Water Board.

MOULDSWORTH PUMPING STATION.
FREEZING OPERATIONS.

The above Board have under consideration the CONSTRUCTION of SUNDRY WORKS at Mouldsworth in Cheshire, including the Sinking of a Shaft to a depth of 450ft. through "running sand" and the New Red Sandstone Rock beneath it, and they INVITE Contractors accustomed to the execution of that kind of work, for which the freezing of the environment is necessary, to SUBMIT TENDERS accordingly. Particulars of what is required may be obtained on application in person to the Engineers, Messrs. G. H. Hill and Sons (Manchester), 40, Kennedy-street, Manchester.

A. J. ROBINSON, Clerk and Manager, West Cheshire Water Board.

11-15, Cross-street, Market-square, Birkenhead, 27th July, 1932. 8815

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SITUATIONS WANTED (continued) Page 2.
AUCTIONS, Page 48.
MISCELLANEOUS, Page 48.
PATENTS, Page 48.
EDUCATIONAL, Page 48.
FOR HIRE, Page 48.
BUSINESSES and PREMISES (For Sale, etc.), Page 48.
FOR SALE, Page 49.
PARTNERSHIPS, Page 2.
MACHINERY, &c., WANTED, Page 48.
AGENCIES, Page 2.
WORK WANTED, Page 48.

For Advertisement Rates see First Column Overleaf.

The Engineer

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This Supplement, which deals with the Science and Practice of Metallurgy, both ferrous and non-ferrous, is published free with the last issue of THE ENGINEER in each calendar month.

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Letters relating to the Advertisement and the Publishing Department of the Paper are to be addressed to the Publisher, all other letters are to be addressed to the Editor of THE ENGINEER.

THE ENGINEER DIRECTORY.

This Directory, which is published annually in the interests of advertisers in THE ENGINEER, may be obtained free of charge on application to the Publisher.

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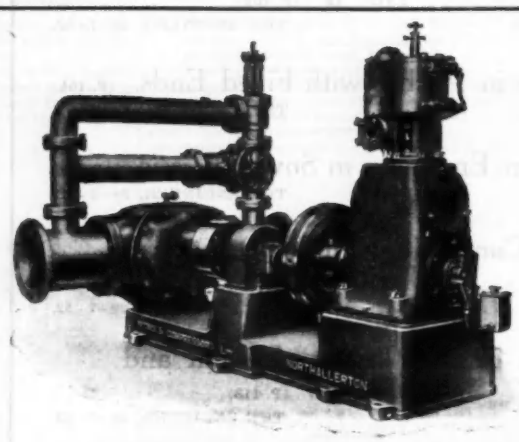
For continuation of Small Advertisements see page 48.



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A Seven-Day Journal

Merseyside Industries.

THE report upon an Industrial Survey of Merseyside, which has been undertaken by the University of Liverpool on behalf of the Board of Trade, was made available at the end of last week. This report, it may be recalled, is one of four surveys, undertaken last year, of which two relating to the Glasgow area and to South Wales, have already appeared. The Merseyside area, dealt with in the new report, includes the county boroughs of Liverpool and Bootle on the Lancashire side of the river and Wallasey and Birkenhead on the Cheshire side, including also five urban districts. In 1930 the number of insured workpeople was 381,000 and at the time the survey was made 28·1 per cent. were unemployed. Of the total number of workpeople, only 37 per cent. are engaged in actual production, compared with an aggregate figure for the whole country of nearly 65 per cent. The remainder are employed in transport, commerce, and various forms of personal or public service, and this group of occupations covers nearly three-quarters of the unemployed. The report points out that the problem of the future of Merseyside industry falls into two parts, the major part being directly concerned with shipping and distribution, which is effected by far-reaching international problems. In discussing possible immediate remedies, the report refers to two types of action, first, the direct transference of workers from the depressed zone to other zones with more power of labour absorption, and, secondly, the achieving of the same end by means of national fiscal and monetary policy, which might direct labour into the desired channels.

The Future of British Shipping.

AT the annual meeting of Furness, Withy and Co., Ltd., which took place in London last week, the chairman of the company, Lord Essendon, perhaps better known to our readers as Sir Frederick Lewis, referred in his speech to the steady deterioration which in the past year had taken place in the British shipping industry. He pointed out that the psychological effect of the continued depression was aggravating a position which was already a bad one. British shipowners, Lord Essendon said, had to compete with the subsidised ships of other countries, and with trade barriers which in some cases were more in the nature of measures of self-defence, and, if anything, were increasing instead of decreasing with a consequent most harmful effect on shipping. In the course of his speech, Lord Essendon referred to the inspiring influence of the Lausanne Agreement and to the Imperial Economic Conference now taking place at Ottawa, the combined effect of which, he hoped, would go a long way towards restoring confidence and setting the wheels of commerce in motion. It might be, he held, that these important developments would mark a turning point in the trade situation. In reviewing the many phases of Furness, Withy's interests, Lord Essendon touched upon the New York–Bermuda service of his company, and stated that the new quadruple-screw turbo-electrically propelled vessel, the "Monarch of Bermuda," had proved an unqualified success.

Wreck Statistics for 1931.

THE statistical summary of ships totally lost, broken up, condemned, &c., just published by Lloyd's Register, shows that during 1931 the gross reduction in the mercantile marine of the world amounted to 622 ships of 1,368,820 tons, excluding all ships of less than 100 tons. Of this total, 558 ships of 1,335,708 tons were steamers and motor ships, and 64 of 33,112 tons were sailing ships. These figures, compared with 1930, show an increase of 103,187 tons as regards steamers and motor ships, and a decrease of 47,651 tons for sailing ships. Tonnage broken up during 1931 amounted to 1,032,712, as against 898,474 tons in 1930, an increase of 134,238 tons, and actual casualties were less by 78,702 tons. The tonnage of ships owned in Great Britain and Ireland which were broken up, dismantled, &c., during 1931 amounts to 314,957 tons. The statistical tables show that strandings and kindred casualties which are comprised under the term "wrecked" are the most prolific cause of disaster. To such casualties are attributable 59·8 per cent. of the number of steamers and motor ships lost and 57·8 per cent. of sailing ships. Cases of abandoned, foundered, and missing ships are, no doubt, frequently more or less similar in the circumstances of loss, and if these be taken collectively they comprehend 20·9 per cent. of steamers and motor ships and 28·9 per cent. of the sailing ships removed from the mercantile marine during 1931, owing to casualty. During 1931 ships broken up, condemned, &c., amounted to no less than 76·2 per cent. of the tonnage of the steamers and motor ships, and 43·9 per cent. of the sailing ships included in the tables. An interesting table gives the number and tonnage of steamers and motor ships of all nationalities lost through marine and war casualties since 1908, exclusive of ships broken up, condemned, &c., not in consequence of casualty or stress of weather. The table also gives for each country the percentage lost of the total tonnage owned. Excluding the five war years 1914–18, during which very high losses were recorded, the average percentage of loss of steamers and motor ships belonging to Great Britain and Ireland during the remaining nineteen years amounts to less than 1 per cent. per annum of the tonnage owned. The world percentage for 1931 was 0·48.

The Retirement of Professor Miles Walker.

THE impending retirement of Professor Miles Walker from the Chair of Electrical Engineering at the Manchester College of Technology will result in the removal of a well-known figure from the profession of electrical teaching. With a wide practical experience in the design of electrical machinery, gained largely during his connection with the British Westinghouse Company, he became Professor at the Manchester College in 1912, and has since been responsible for the training of many young electrical engineers. Originally he was a student at the Finsbury Technical College under Professor Silvanus P. Thomson, who ultimately made him his assistant. Subsequently he went to Cambridge to work under Sir Alfred Ewing, who recommended him as a suitable person to join the party known as the "Holy Forty," which went out to the American Westinghouse Company with a view to learning its methods before starting in England. There he worked under Mr. B. G. Lamme, the company's chief electrical engineer. In 1903 he returned to England, and joined the British Westinghouse Company, now the Metropolitan-Vickers Electrical Company. During his connection with that firm he devoted himself to many electrical problems, and read several papers before the Institution of Electrical Engineers. His best-known work is perhaps that in connection with phase advancers, in which he still seems to take a keen interest. At one time he also paid considerable attention to rotary converters, and was, we believe, largely responsible for the introduction of the radial commutator for high-speed machines. He is the author of several electrical books, of which that on "The Diagnosis of Troubles in Electrical Machinery" is probably the best known and appreciated.

The Iron and Steel Industry.

AN official report on the second meeting of the National Committee for the Iron and Steel Industry, which met in London last week and approved the general lines of policy of the special committee, has now been issued. It states that four regional committees are dealing respectively with the North-East Coast, Scotland, South Wales, and Midland areas, while four other committees, will deal with costing, wrought iron forgings, armaments, and Sheffield special steels, the work of these various committees being co-ordinated by an executive committee of the National Committee. The problems which are being considered include schemes for co-operation with consumers, organisation of production in relation to demand, improved selling arrangements, exchange of information and costs, possibilities of amalgamation between similar interests, and the important question of redundant capacity. Assisted by the Government's promise of adequate protection, the various committees are approaching their problems in no individualistic or selfish spirit, but with a desire to co-operate for the benefit of the whole. There appears to be a spirit of give and take, which, combined with determination, gives, the report asserts, an assurance that the problems of the industry will eventually be solved and its prosperity restored.

New Electricity Committees.

IN accordance with Sec. 3 of the Electricity (Supply) Act, 1926, the Central Electricity Board may appoint consultative technical committees, consisting of engineers associated with electricity supply undertakings. In order to establish its relations with undertakings throughout the country, the Board has decided to form District Committees in Scotland, North-East England, North-West England, Mid-East England, Central England, South-East England, and South-West England. The engineers who have been invited to become chairmen of these Committees are respectively Mr. E. T. Goslin, of the Clyde Valley Electrical Power Company; Mr. H. A. Couves, Newcastle Electric Supply Company; Mr. H. C. Lamb, Manchester Corporation; Mr. W. B. Woodhouse, Yorkshire Electric Power Company; Mr. J. T. H. Legge, Shropshire, Worcestershire, and Staffordshire Electric Power Company; Dr. S. L. Pearce, London Power Company; and Mr. A. Nichols, Newport Corporation. A National Committee is also being formed to deal with matters of general importance, and the engineers who have been invited to serve on this Committee are Mr. C. D. Taite, of the Lancashire Electric Power Company; Mr. C. G. Morley New, Cardiff Corporation; Mr. R. P. Sloan, Newcastle Electric Supply Company; Mr. W. J. H. Wood, County of London Electricity Supply Company; Mr. F. W. Purse, London and Home Counties Joint Electricity Authority; Mr. W. C. P. Tapper, Incorporated Municipal Electrical Association; Mr. G. Porter, Worthing Corporation; Mr. T. Roles, Bradford Corporation; Mr. F. Forrest, Birmingham Corporation; Mr. R. W. Phillips, Bedford Corporation; Captain J. M. Donaldson, North Metropolitan Electric Supply Company; Mr. William McGill, Grampian Electric Supply Company; Mr. P. J. Robinson, Liverpool Corporation; and Mr. K. A. Scott Moncrieff, Provincial Association.

A Coal Products Conference.

ON Tuesday last, July 26th, a conference convened by Mr. Isaac Foot, the Secretary for Mines, was held at the Mines Department in order to consider problems of coal utilisation. Besides Mr. Foot, there were present the principal officials of the Mines Department and the Fuel Research Department, and a group representing a wide range of the industries interested, including Colonel W. A. Bristow, Chairman of the Low-Temperature Coal Distillers' Association; Sir H. E. Brittain; Sir A. L. Dickinson; Sir E. W. Glover, Past-president of the Chamber of Shipping; Lieut.-Colonel J. H. M. Greenly, Babcock and Wilcox, Ltd.; Mr. P. Lee, President of the Miners' Federation; Mr. W. A. Lee, Secretary of the Mining Association; Sir J. Milne, Chairman of the Railway Managers' Conference; Sir D. Milne-Watson, President of the National Gas Council; Sir R. A. Pease, Pease and Partners, Ltd.; Mr. C. D. Taite, President of the Association of Electric Power Companies; Mr. B. Talbot, Past-president of the National Federation of Iron and Steel Manufacturers; and Sir Alexander Walker. The present position was fully reviewed, and the whole of the organisations which are concerned in improving the methods of using coal and coal products and of stimulating their wider use were brought under survey. The Conference was of the unanimous opinion that every practicable step should be taken to impress upon the country the urgent necessity of securing the widest possible use of coal and coal derivatives, and several suggestions to secure that end were made.

A Glasgow Railway Station Improvement.

WITHIN the last few days alterations to the Buchanan-street Station of the London, Midland and Scottish Company at Glasgow have been completed, and the station now presents a pleasing appearance, quite different from the familiar old-fashioned timber-roofed structure and entrance, which, erected as a temporary measure in 1849 when the station was first opened, remained until February of this year, when rebuilding was begun. The station has been greatly improved by the provision of a larger concourse area and booking-hall with a glass-covered roof. The train information indicator has been set back to give a larger area of approach to the main platforms, Nos. 1 to 4, which are now roofed in glass supported on light steel columns. It is interesting to record that the steelwork and glass for the new Buchanan-street Station construction has been taken from the company's Ardrossan (North) Station, which will shortly be closed for traffic. The whole of the alterations have been made without any serious interruption of the busy traffic of the terminus, and the approach from Buchanan-street to the station is now to be remodelled, which, when completed, will give a still more pleasing setting to the new façade and the covered porch of the station just completed.

The Late M. Santos Dumont.

A MESSAGE received from Rio de Janeiro at the beginning of this week reported the death of Monsieur Santos Dumont. This report has now been confirmed. Monsieur Dumont had lately been seriously ill, and died, we learn, on Saturday, July 23rd. He was born fifty-nine years ago at Sao Paulo, and, coming to Europe as a young man, took up the study of aeronautics. His first balloon flight at the age of twenty-four inspired him to attempt the production of a navigable balloon.. Between 1898 and 1906 he constructed many small machines, which were later developed into the non-rigid airship type. On October 9th, 1901, he won the Deutsch prize of 15,000 dollars for a flight from St. Cloud round the Eiffel Tower and back in a given time. The balloon, the sixth dirigible built by Santos Dumont, was 108ft. long and 20ft. in diameter, and was propelled by a 16 horse-power petrol automobile engine. Subsequently he built at least six more dirigibles. To him also is due the first public and successful flight in a power-driven aeroplane in Europe, which was made on August 22nd, 1906. Orville and Wilbur Wright had, of course, flown in 1903 at Dayton, Ohio. On October 23rd, 1906, Santos Dumont achieved a flight of 240 yards in 21 sec. From 1907 to 1909 he designed and flew a "tail-first" type of biplane, and in the latter year he designed a parasol type of monoplane, in which the wing was well above the engine and the cockpit, with the pilot enclosed in a cage. It was claimed to give the pilot almost complete immunity from injury in a crash. This machine was flown at the first aviation meeting at Bournemouth in 1910, and was known as the "Demoiselle" or "Flying Grasshopper." Even although little trace of Santos Dumont's work can be found in modern aircraft practice, the inspiration that he afforded in days when flying was not regarded seriously would serve to place him in the front rank of aircraft pioneers.

The Economics of Urban Electric Railways.

By HENRY WATSON.

No. II.*

SUBURBAN ELECTRIFICATION—REVENUE INCREASE NEEDED.

IN the first article of this series estimates of the operating cost of steam and electric suburban services were given, and the variation of the cost per train-mile, of the electric service, according to the service frequency, was shown in two graphs, one for a constant service interval throughout the day, and the other for services where the slack period interval was 50 per cent. greater than that during rush hours. It was shown that fast electric trains were cheaper in operating cost than steam ones with high-frequency services, whilst slow electric trains, of the same speed as the steam ones, were cheaper for both medium and high frequencies.

It is necessary to discuss these conclusions at some length, in order to appreciate the requirements of electrified lines in the way of revenue increase needed to justify the improved service invariably given. Table VIII. shows the cost of providing, maintaining, and running trains, first in terms of pence per train-mile—derived from Figs. 1 and 2, in the first article—and then in terms of pounds per mile of

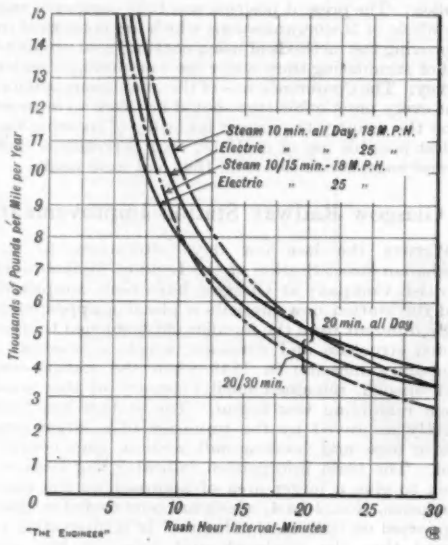

Thousands of Pounds per Mile per Year
Steam 10 min. all Day, 18 M.P.H.
Electric " " 25 "
Steam 10/15 min.-18 M.P.H.
Electric " 25 "
20 min. all Day
20/30 min.
Rush Hour Interval-Minutes
"THE ENGINEER"

FIG. 3

route annually. The steam train costs per train-mile are unaffected by the service frequency, but the electric train costs per train-mile, decrease with increasing frequency, owing to the declining magnitude of all those costs involved in delivering current to the train, *i.e.*, on track equipment, sub-stations, &c. The costs per mile of route, for steam and electric services, are plotted in Fig. 3.

The steam service curves are hyperbolas, but the electric service curves do not rise so quickly, and therefore fall below them at high service frequencies. This is more clearly shown in Fig. 4, where only the difference in cost of steam and electric services (with slack to rush intervals of ratio 3 to 2) is shown. The point where an electric service becomes cheaper is then more apparent. These curves record the difference between the cost of a steam service and an electric one of the same or of higher speed, and of the same or higher frequency, as derived from Table VIII. Thus, a 10/15-minute steam service costs £8140 per mile per year, and a 10/15-minute fast electric one costs £7900, or £240 less, as shown by the second curve from the bottom. A 5/7½-minute fast electric service—giving 100 per cent. more mileage—costs £14,800, demanding £6660 more (see top curve). Let us consider these curves in detail.

Cost of Unimproved Service.—The lowest curve shows the extra cost, or saving, resulting when operating electrically, no improvement in speed or frequency being attempted, and only economy of operation being sought. As noted in the first article, electric traction is then slightly cheaper with intervals of less than 25/37½ minutes, for the rush and slack periods respectively, or, say, with thirty-four or more trains per day each way. With a 20/30-minute service, the saving is, however only £175 per mile annually, though it reaches to £1340 with a high-frequency, 10/15-minute service. The capital investment per mile would then be £10,000+£23,000=£33,000 (see Estimate B, with double rolling stock), and the saving would amount to 4 per cent. on this, over and above the 5 per cent. interest already charged. Clearly, the saving by electric traction with unimproved services is, in general, trivial, though there are certain high-frequency steam services—*e.g.*, passing eighty or more trains per day each way—where it would be sufficiently substantial to return 8 per cent. or more,

* No. I. appeared July 22nd.

with interest charges, on the capital demanded for electrification. Sub-stations are excluded, the cost of current covering 5 per cent. on their capital.

Cost of Faster Service.—It is a characteristic of suburban electrification economics that substantial improvements of service are possible for slight increases of revenue, and thus in such schemes we must look to the revenue or credit side of the account rather than to the cost or debit side for their justification. It is practicable to demand a higher standard of service from electric trains, principally because of the high

TABLE VIII.—*Costs of Providing Steam and Electric Services.*

Service.	Service intervals. Rush hours.	Service intervals. Slack hours.	Trains per day each way.	Annual mileage per route mile.	Cost per train-mile.	Cost per route mile.
A. *Steam*:	Min.	Min.			d.	£
Slack interval = 1·5 rush interval ..	5	7½	168	118,400	33	16,280
	10	15	84	59,200	33	8,140
	15	22½	56	39,460	33	5,427
	20	30	42	29,600	33	4,070
	30	45	28	19,730	33	2,713
Slack interval = rush interval	5	5	216	157,600	31	20,360
	10	10	108	78,800	31	10,180
	15	15	72	52,600	31	6,787
	20	20	54	39,400	31	5,090
	30	30	36	26,270	31	3,393
B. *Slow Electric*:						
Slack interval = 1·5 rush interval ..	5	7½	168	118,400	25·5	12,600
	10	15	84	59,200	27·5	6,800
	15	22½	56	39,460	28·5	4,700
	20	30	42	29,600	31·5	3,880
	30	45	28	19,730	35	2,880
C. *Fast Electric*:						
Slack interval = 1·5 rush interval ..	5	7½	168	118,400	30	14,800
	10	15	84	59,200	32	7,900
	15	22½	56	39,460	36	5,920
	20	30	42	29,600	36·5	4,500
	30	45	28	19,730	40·5	3,340
Slack interval = rush interval	5	5	216	157,600	25·6	16,800
	10	10	108	78,800	27·5	9,050
	15	15	72	52,600	29·5	6,460
	20	20	54	39,400	31	5,100
	30	30	36	26,270	35	3,830

overload capacity of the electric motor, and the distribution of propulsive equipment along the train overcoming adhesion difficulties, which usually preclude high acceleration with locomotives in all weathers.

With stops 1¼ miles apart, a speed of, say, 25 m.p.h., as against 18 m.p.h., is practicable and commercially justified. This 40 per cent. speed-up costs only £430 more per mile, at 20/30-minute intervals, *i.e.*, with forty-two trains per day each way. This may be only 4 per cent. of the total revenue of the line.

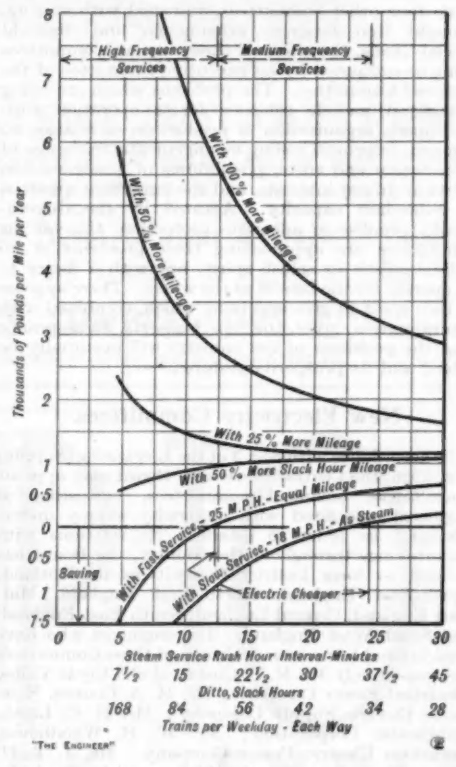

Thousands of Pounds per Mile per Year
High Frequency Services
Medium Frequency Services
With 100% More Mileage
With 50% More Mileage
With 25% More Mileage
With 50% More Slack Hour Mileage
25 M.P.H.-Equal Mileage
With Fast Service
With Slow Service,-18 M.P.H.-As Steam
Saving
Electric Cheaper
Steam Service Rush Hour Interval-Minutes
7½ 15 22½ 30 37½ 45
Ditto, Slack Hours
168 84 56 42 34 28
Trains per Weekday - Each Way
"THE ENGINEER"

FIG. 4

With high-frequency services the faster electric service may even be cheaper, for we see that the second curve in Fig. 4 descends below the zero line at 12½-minutes rush interval, or, say, sixty-six trains per day. There are certain high-frequency steam services in London where a 40 per cent. faster electric service might even be cheaper than the present steam service. Certainly the extra cost, where close on 100 trains per day pass each way, would be definitely quite trivial in relation to the total revenue. We may say that where there are some thirty-four or more trains per day each way, and high-tension current is available at ½d. per unit, the extra cost of a 40 per cent. faster electric service will rarely exceed £500 per mile of route annually, or, say, 6 per cent. of the total revenue.

Cost of More Frequent Service.—The third curve up in Fig. 4 shows that we can demand a 40 per cent. faster service, with 50 per cent. more slack hour mileage, *i.e.*, with increased frequency as well, for rarely more than £1000 per mile of route annually. The extra amount is largely independent of the service frequency as the greater saving per train mile—over steam costs, with the higher frequency services—offsets the greater number of extra train miles to be run. Thus a 20/30-minute steam service costs £4070 per mile to provide. A 20/30-minute fast electric one costs £4500, or £430 more; whilst a 20-minute all-day service costs £5100, or £1030 more than the steam service. If the steam service has earned £12,000 per mile annually, or 98d. per train mile, these extras are only 3½ per cent. and 8½ per cent. respectively. Thus for less than 10 per cent. increase of revenue we can secure, where there are thirty-four or more trains per day each way, a 40 per cent. faster service and a 50 per cent. more frequent mid-day one, *e.g.*, a 25 m.p.h., 20-minute all-day, electric service, as against an 18 m.p.h., 20-minute rush, 30-minute slack, steam one.

The cost of running additional mileage in slack hours with electric trains, which are already in stock, can hardly exceed, say, 18d. per mile for a four-coach, 130-ton train. This figure may be made up of:—Power, 9d.; wages, 3d.; and additional maintenance of train and track, 6d. The other charges, *e.g.*, for providing the train, have already been met. This allowance will be found to agree with the total costs of services worked out from Figs. 1 and 2. Thus a 20/30-minute service involves 29,600 miles at 36·5d. per mile, equal to £4500. A 20-minute all-day service, entailing 39,400 miles at 31d., costs £5100. The extra 9800 miles cost £600 more, or 15d. each, which is close enough.

On some steam suburban lines the mid-day service interval is so long as to make the service then virtually non-existent, the railway being almost entirely a rush hour facility. Slack hour riders can then find accommodation on road vehicles, are not acquainted with the train times, are often not pressed for time, and more attracted by road facilities.

For these reasons many suburban railways have very little slack hour service. In these cases the amount of increase required to pay for electric services must be greater, as, of course, infrequent electric mid-day services are impracticable because the cost per train-mile would be unwarranted. But in such cases the increase almost means the difference between opening and shutting the stations during slack hours.

There is thus a strong case for electrification where fairly frequent steam services are already provided, due to the fact that a very slight increase of revenue will cover a marked improvement in speed and slack hour frequency, whilst there is the strongest possible case where high-frequency steam services are being operated. No great increase of train mileage need then be considered, and no great expectations of improved revenue are essential to provide a very satisfactory return on the capital invested. This latter point is important, *i.e.*, whether or not a very substantial increase of train mileage is contemplated. If not, then our anticipations can be very modest, and we may say that a 10 per cent. revenue increase, or of £1000 per mile annually, would suffice to cover a 40 per cent. speed-up and a 50 per cent. increase of slack hour frequency where already thirty-four or more steam trains pass each way per day.

Cost of Substantially Improved Services.—But several electrification programmes provide, or con-

template providing, a very substantial increase of train-mileage all day long, and in some cases up to 100 per cent. increase. Naturally, they demand considerable increases of revenue, though not, of course, in proportion. The upper three curves in Fig. 4 indicate the extra cost entailed, for providing fast electric services with 25 per cent., 50 per cent., and 100 per cent. more train-mileage than is run with steam trains, the increase being spread over rush and slack hours in equal ratio. Thus, a 20/30-minute steam service costs £4070 (see Table VIII.) and a 10/15-minute electric one costs £7900, or £3830 more (see top curve in Fig. 4 at forty-two trains per day).

Route Expenses.—It is more convenient to discuss revenue increases needed in the form of percentages of the total. A better appreciation of their magnitude is then possible. To do this we require to know or assume the value of those expenses of providing, maintaining, and staffing the railway, apart from those involved in providing and running the trains. These expenses may be called route expenses, as they are very largely independent of the service frequency, at least sufficiently so for our purpose. Such expenses will include interest on the construction cost, or dividends, and thus, added to the train expenses, will equal the total revenue. The following figures suggest a high and a low value for these route expenses in respect of a fairly remunerative suburban line of pre-war construction :—

	Per mile of route annually. Low. £	High. £
Wages at stations	1,500	2,000
Maintenance of way and structures	1,500	2,000
General expenses and rates	1,000	2,000
Various traffic and other expenses	500	1,000
5 per cent. dividend on £70,000/£100,000	3,500	5,000
	£8,000	£12,000

We may take a mean value of £10,000 per mile. This will demand a revenue per train-mile, with a 20/30-minute steam service, of 114d. (29,600 miles for a total of £14,070). With double the service, however, it need be only 74d. The proportionate increase of revenue needed can now be determined, and this is shown in Fig. 5 for the same conditions as governed Fig. 4.

Thus to replace a 20/30-minute steam service, costing £14,070 per mile all-in, with a fast electric one, having 10/15-minute intervals costing £17,900 all-in, demands a 27 per cent. increase of revenue, *i.e.*, for double the mileage—see upper curve in Fig. 5. We

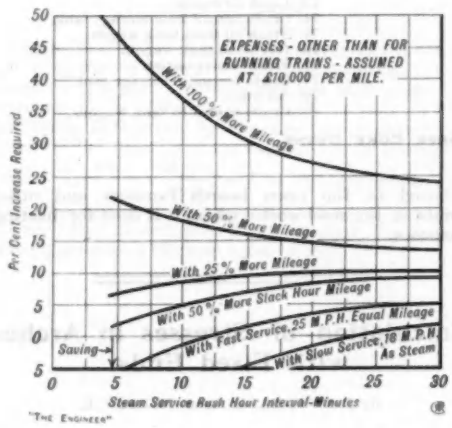

EXPENSES - OTHER THAN FOR RUNNING TRAINS - ASSUMED AT £10,000 PER MILE.
With 100 % More Mileage
With 50 % More Mileage
With 25 % More Mileage
With 50 % More Slack Hour Mileage
With Fast Service, 25 M.P.H. Equal Mileage
With Slow Service, 18 M.P.H. As Steam
Saving
Per Cent Increase Required
Steam Service Rush Hour Interval-Minutes
"The Engineer"

FIG. 5

may observe that a 40 per cent. faster electric service, with double the train mileage—half the service interval all day long—may very probably cost 25/30 per cent. extra—for medium frequency services (up to fifty-six steam trains per day)—or from 30 per cent. to 50 per cent. with high frequency services, *e.g.*, from 60 to 120 per day. Such substantial increases of service naturally demand appreciable revenue increases, and our next article will debate the probabilities of such forthcoming. Meanwhile we may conclude that schemes contemplating no substantial increase of rush hour frequency, where a fair steam service is maintained, provide attractive possibilities which in no way demand an optimistic outlook in this direction.

(To be continued.)

ACCORDING to the *Electrician*, a controversy is in progress in France as to whether a transformer is or is not "movable machinery" within the meaning of the law in regard to rating of plant. Heavy transformers are, of course, usually mounted on wheels, sometimes on rails, so that they can be readily moved into a workshop or depot for repairs or overhaul. Hence the controversy as to whether they are fixed or movable plant. It appears that a single transformer, however large, resting on the floor is officially held to be a "movable," but the presence of rails fixed to the floor or other attachments apparently conveys a "fixed" character to these devices.

Becker Coke Oven and By-Product Plant at Scunthorpe.

No. II. (*conclusion*).*

AFTER quenching, the coke is discharged on to an inclined coke wharf about 130ft. long, running alongside the quenching car track. This wharf is constructed of reinforced concrete covered with hard-burnt blue bricks laid on edge. The coke spreads out on the wharf and cools. It is then allowed to fall through hand-operated regulating finger type gates on to a 36in. belt conveyor which conveys it to the screening plant. A hose service is provided for drenching any hot patches of coke which may have escaped the quenching.

The conveyor delivers the coke through a chute into a double-deck Gyrex screen, capable of separating all the coke about 1¼in. in size and screening the remainder into two sizes, 1¼in. to ¾in. and ¾in. to 0in. The 1¼in. to ¾in. is remixed with the coke over 1¼in., and the whole of this material is conveyed by belt conveyors to the blast-furnace storage bins. It has been found that the mechanical strength and combustibility of the coke are so good that approximately 95 per cent. of the total coke produced can be used

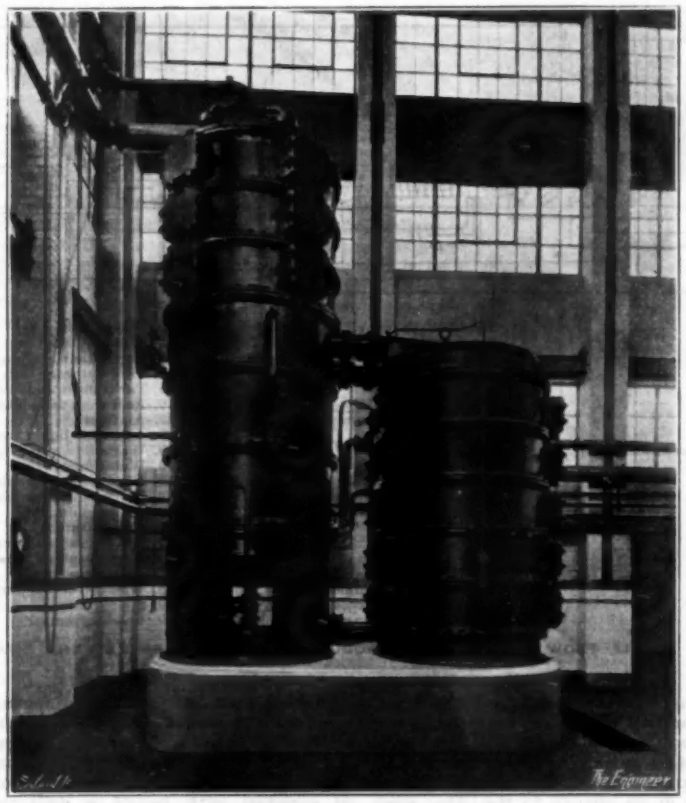


FIG. 11—AMMONIA STILL

in the blast-furnaces, leaving only 5 per cent. as breeze, which is used for heating purposes in other parts of the works.

The coke oven gas leaves the ovens through ascension pipes and passes into a steel gas collecting main. One ascension pipe lined with special insulating material is provided for each oven, and each pipe is fitted with a spray pipe for liquor flushing. Sprays are also provided on the main at alternate ovens. From the gas collecting main the gas passes into an offtake main supported on a steel bridge over the pusher track at the centre of the length of the ovens. The offtake main is connected at the end of the bridge with a suction main which terminates at a downcomer before the primary coolers, which are plainly shown in Fig. 10 *ante*. The flushing liquor, which runs in a closed circuit, is returned at the downcomer to a liquor-flushing and separating tank of approximately 39,500 gallons capacity. Two liquor flushing pumps, one electrically driven and the other steam turbine driven, are provided, one acting as a spare to the other. Special liquor strainers are placed after the pumps to prevent suspended matter reaching the sprays. An Askania gas pressure regulator, consisting of a butterfly valve in the offtake main, controlled by a governor in the reversing machinery house, regulates the pressure in the gas collecting main, and ensures that the ovens are not subjected to a negative pressure.

The process of ammonia recovery employed is the semi-direct system, and may be described as follows, in conjunction with the flow sheet, Fig. 12 :—The gas passes from the ovens to the primary coolers, which are of the indirect vertical water-cooled type. Two coolers are normally in operation, and one is provided as a standby. Another cooler is being installed, with the object of reducing to a minimum the water-vapour content of the gas. The present relation of the wet and dry bulbs of the thermometers at the coolers is approximately 20 deg., but it is expected that this discrepancy can be reduced to 10 deg. In these coolers tar and ammoniacal liquor are condensed. In order to maintain uniform temperature of the gas leaving the coolers, automatic temperature controllers are provided, operating the water supply mains to each cooler.

From the primary coolers the cooled gas is passed to two Lodge-Cottrell electrical tar precipitators, Fig. 13, page 112, each operated by a Lodge-Cottrell transformer set. The detarrers consist of a series of vertical tubes in cylindrical shells. The gas containing tar fog passes up these tubes, and is subjected to an electrical discharge emanating from the electrodes which hang down each tube. The particles of tar on being charged are attracted to the pipes and reaching the walls of the tubes lose their charge and flow down to the tar well. The gas meets with no hindrance, and is in itself unchanged by this treatment, except that it is now clear of tar. Over 99·5 per cent. of the tar contained in the cooled gas is removed in the precipitators. In an adjoining house two sets of electrical equipment (either of which is large enough for both de-tarrer units) step up the low-voltage supply to some 60,000 volts.

The high degree of tar extraction prevents the tendency of the wash oil to thicken, and gives a very white ammonium sulphate in the ultimate by-product. The absence of any mechanical action upon the mixture has the advantage that the tar separates readily from the water and it is easy to draw off the tar from the tanks practically free from water.

Two single-stage, Bryan Donkin, steam-driven, Rateau turbo-exhausters —see Fig. 14, page 112— are provided to drive the gas through the system. Each of them is capable of passing all the gas produced at the ovens, and delivering it against a normal back pressure of 2¼ lb., when running at a speed of 8400 r.p.m. Each exhauster is direct coupled to a Rateau multi-stage steam turbine, operating with steam at 100 lb. per square inch and working against a back pressure of 15 lb. per square inch. The low-pressure exhaust steam from the turbines is used in the ammonia and benzol stills. In order to ensure a uniform steam pressure in the by-product plant, an Askania regulator on the main steam line is provided. Askania regulators operating on the servo motors of the exhauster turbines are also provided for ensuring constant suction at the gas inlet to the primary coolers. They are provided with special overtaking gear to prevent hunting.

From the exhausters the cooled gas is passed through a reheater before entering the ammonia saturators—Fig. 15—two of which are provided, one acting as a standby. The ammonia saturators consist of steel shells resting on cast iron bottoms and provided with dome-shaped cast iron tops. They are lead-lined and are provided with lead cracker pipes. The gas bubbles through the sulphuric acid contained in them and passes to the acid separators, where any traces of sulphuric acid are removed. One separator is provided for each saturator. The saturators and separators are placed in the open, and not in the sulphate house, as has hitherto been the practice in this country, and in this way the size of the house is materially reduced, while repair and maintenance of the saturators and separators are facilitated. It is not anticipated that with the English climate any trouble will accrue through this policy. For discharging the sulphate produced, each saturator is provided with a bronze salt ejector, which, in turn, is provided with a bronze separator for removing air from the wet sulphate before it enters the drain table, which consists of a lead-lined cast iron box.

After draining, the sulphate is dried in centrifuges, two of which are provided, each having a capacity of approximately 600 lb. of sulphate. The centrifuges are of the suspended, self-balancing type, driven by electric motors through belting. From the centrifuges the sulphate is fed by a band conveyor into a Wilton

* No. I. appeared July 22nd.

drier—Fig. 16—which dries and neutralises the sulphate. The dry neutral sulphate is discharged into an elevator, which delivers it to a bagging hopper of 30 cwt. capacity, fitted with a weighing machine and a gate for discharging into bags.

The ammonia condensate from the primary coolers is distilled in a still—Fig. 11—situated in the same building as the benzol apparatus, so that these plants may both be under the charge of one operator. An orifice type meter is used for measuring the ammonia liquor entering the still, which is also provided with a waste liquor trap. Lime slacking and mixing apparatus is provided in an annexe to the benzol plant building, while two electrically driven open impeller type pumps are installed for supplying the lime water to the still. One pump acts as a standby to the other.

The ammonia liquor from the liquor compartment of the flushing and separating tank is pumped into a weak ammonia liquor storage tank having three days' storage capacity. Two electrically driven centrifugal pumps are provided to transfer the liquor from the storage tank to the ammonia still, one pump being a standby. Waste liquor from the still is received in a waste liquor settling basin from which the decanted liquor is allowed to run away by drains. The tar from the tar compartment of the liquor flushing and separating tank is pumped by means of a steam-driven pump into a tar storage tank having seven days' storage capacity. Another tar pump of similar capacity and drive is provided for pumping tar from the storage tanks into wagons. The drainages from the exhausters and tar extractors and the overflows from the tar and ammonia tanks are received by a condensate drain pit and are pumped therefrom by a float-controlled pump into the liquor flushing tank. A mother liquor tank receives the mother liquor drained from the saturators and the acid separators and from the acid drip in the gas main after the separators. The mother liquor is delivered from this tank to the saturators by means of a bronze acid ejector. Acid for the saturators is stored in a 10,000-gallon storage tank. A 2250-gallon elevated acid feed tank for the saturators is also provided.

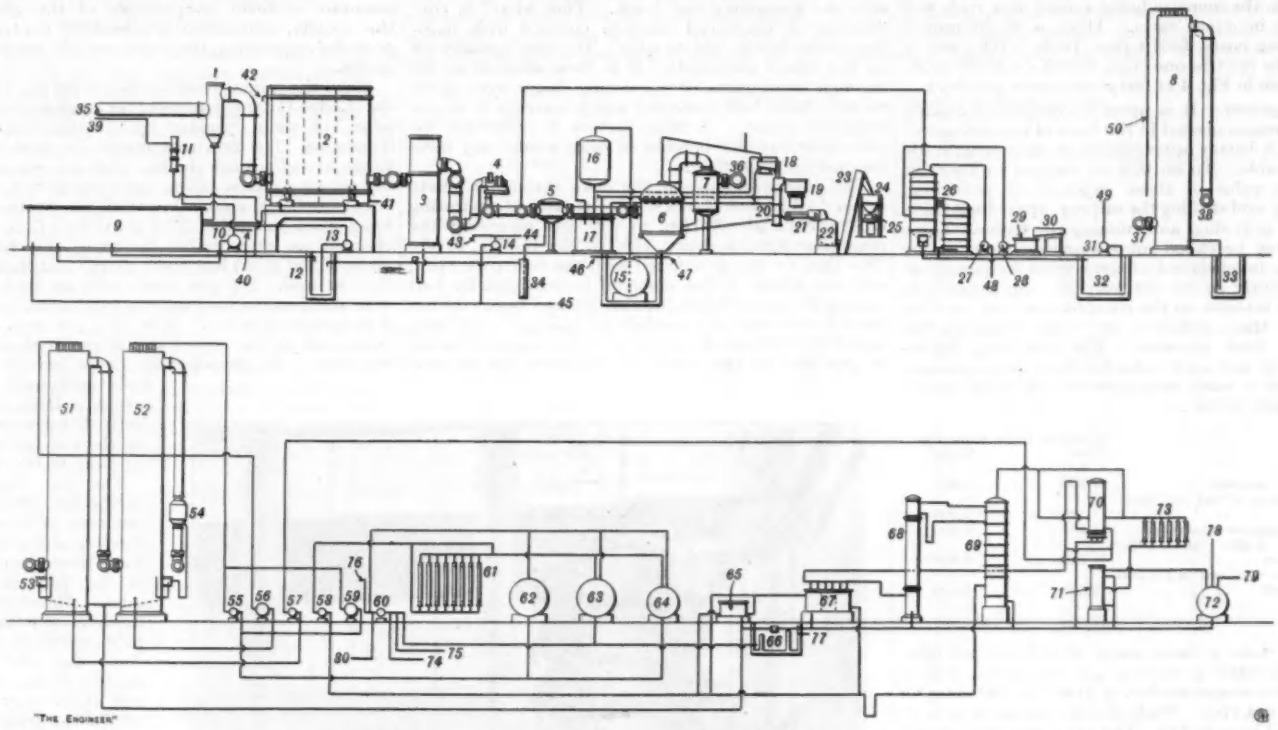
The exhausters, reheater, sulphate drain table, centrifugal driers and tar and liquor pumps are housed in the by-product building, an extension of which forms the sulphate store, the exhausters and centrifuges being arranged on a gallery—see Fig. 14. The by-product building is divided into two rooms by a partition wall, which separates the sulphate store from the apparatus room. A 3-ton hand-operated crane is provided. The lime store and lime slacking and mixing apparatus are situated in an annexe to the benzol plant building, which, as mentioned above, houses the ammonia still.

After leaving the by-product recovery building, the gas passes through a hurdle type final cooler, where the naphthalene is removed. The cooling water passes to a naphthalene separating sump of 700 cubic feet working volume. After final cooling the gas is debenzolised in two tower scrubbers 95ft. high and packed with wooden hurdles. The gas passes up through the towers and meets a descending stream of wash oil, which absorbs the crude benzol. The wash oil enriched with benzol is delivered into a distilling apparatus provided with the necessary heat exchangers, condensers and coolers—Fig. 18.

On its way to the still the cool benzolised oil first passes through a meter and into a vertical tube type vapour-to-oil heat exchanger, wherein heat is transferred from the light oil vapour leaving the still to the benzolised wash oil. It then passes through an oil-to-oil heat exchanger, where heat is transferred to it from the hot debenzolised wash oil leaving the still. It is thereafter steam-heated in a final heater, two of which are provided, one acting as a standby. On leaving the final heater, the preheated wash oil enters the cast iron still, composed of a series of fifteen trays, where the crude benzol is removed by intimate contact with steam. The crude benzol vapour passes from the still through the vapour-to-oil heat exchanger, into an open type light oil final cooler with six banks of 3in. pipes, and thence into a light oil separator for separating the benzol from the cooling water. From the separator the crude benzol flows to one of two receiving tanks, whence it is raised by compressed air into a crude benzol drain and storage tank of 25,000 gallons capacity. A steam-driven reciprocating pump is provided for loading the crude benzol into tank wagons.

The hot debenzolised oil from the wash oil still passes through the oil-to-oil heat exchanger and to a hot oil drain tank. Thence it is delivered by an electrically driven reciprocating pump to the wash oil cooler. This cooler has eight banks of 2in. galvanised pipes. The cooled wash oil then flows to the wash oil circulating tank, whence it is pumped over the No. 2 scrubber. Two electrically operated centrifugal wash oil circulating pumps, each of 10,000 gallons capacity per hour, are provided for this duty, one pump acting as standby. A third circulating pump pumps the oil from No. 2 scrubber over No. 1 scrubber. Two wash oil storage tanks, of 10,000 gallons capacity each, are provided, one for storing fresh wash oil, and one for storing old wash oil.

The gas issuing from No. 2 scrubber passes through an oil separator of the vertical downflow type, and through a Venturi meter to a single-lift gasholder of 100,000 cubic feet capacity. Thence it is distributed to the open hearth furnaces and other points in the steel works, where it is used for heating purposes.



1. Downcomer.
2. Primary cooler.
3. Tar precipitator.
4. Exhauster.
5. Reheater.
6. Saturator.
7. Acid separator.
8. Final cooler.
9. Liquor flushing and separating tank.
10. Liquor flushing pump.
11. Liquor strainer.
12. Condensate drain pit.
13. Condensate pump.
14. Tar pump.
15. Acid storage tank.
16. Acid feed tank.
17. Mother liquor tank.
18. Drain table.
19. Centrifugal drier.
20. Drip pot.
21. Sulphate conveyor.
22. Sulphate neutraliser and drier.
23. Sulphate elevator.
24. Bagging hopper.
25. Weighing machine.
26. Ammonia still.
27. Ammonia liquor pump.
28. Lime pump.
29. Lime mixer.
30. Lime slaking box.
31. Waste liquor pump.
32. Waste liquor settling basin.
33. Naphthalene separating sump.
34. Seal pot.
35. Gas from ovens.
36. Gas to final cooler.
37. Gas from acid separator.
38. Gas to benzol scrubber.
39. Ammonia liquor to ovens.
40. Ammonia liquor to storage tank.
41. Water inlet.
42. Water outlet.
43. Tar to tank wagons.
44. Tar to storage tank.
45. Tar from storage tank.
46. Acid from tank wagon.
47. Air inlet.
48. Ammonia liquor from storage tank.
49. Waste liquor delivery.
50. Water inlet.
51. No. 1 benzol scrubber.
52. No. 2 benzol scrubber.
53. Oil screening box.
54. Oil separator.
55. No. 2 scrubber pump.
56. No. 1 scrubber pump.
57. Apparatus pump.
58. Wash oil cooler pump.
59. Spare pump.
60. Loading pump.
61. Wash oil cooler.
62. Fresh oil tank.
63. Old oil tank.
64. Wash oil circulating tank.
65. Hot oil drain tank.
66. Oil separating sump.
67. Oil to oil heat exchanger.
68. Final heater.
69. Wash oil still.
70. Vapour to oil heat exchanger.
71. Light oil separator.
72. Crude benzol receiving tank.
73. Light oil cooler.
74. Crude benzol from storage tank.
75. Fresh oil from tank wagon.
76. Old oil to tank wagon.
77. Waste water outlet.
78. Crude benzol to storage tank.
79. Air inlet.
80. Crude benzol to tank wagons.

FIG. 12—FLOW SHEET OF BY-PRODUCT RECOVERY PLANT AT THE SCUNTHORPE COKE OVENS

Calculation of Stresses in Arches with Fixed Ends.

By J. D. W. BALL, Assoc. M. Inst. C.E.

THE calculation of the stresses in an arched bridge with fixed ends is of such a laborious nature that any simplification that can be made, without unduly detracting from the accuracy of the solution, will assuredly be welcome. The method about to be described is partly graphical, and thus possesses the advantage of visual control of errors of any magnitude. At the same time any reasonable degree of accuracy can be obtained by careful drawing to a sufficiently large scale, and the small differences between quantities upon which the final accuracy of the solution depends can always be calculated.

To make the solution complete, the derivation, from generally accepted principles, of the conditions to be satisfied, will be briefly indicated. In Fig. 1 ds is an extremely short length of an arch with fixed ends at A and B. Throughout this short length the bending moment may be supposed to be constant and equal to M. If the angle subtended by this length before bending is θ and due to the bending moment M is changed to θ_1, the length of a fibre distant x from the neutral axis will have changed from $ds+\theta x$ to $ds+\theta_1 x$, the difference being $x(\theta-\theta_1)$ or $\frac{x(\theta-\theta_1)}{ds+\theta x}$ per unit of length. The maximum stress f, due to the bending moment M, is $\frac{My}{I}$, where y is the distance of the extreme fibre from the neutral axis and I is the moment of inertia of the section. The stress on the fibre under consideration is

$$\frac{x}{y}\times\frac{My}{I}=\frac{Mx}{I}$$

Therefore, E, the modulus of elasticity, is :

$$\frac{M\,x}{I} \div \frac{x\,(\theta-\theta_1)}{d\,s+\theta\,x}$$

and $$\theta-\theta_1=\frac{M\,(d\,s+\theta\,x)}{E\,I}=\frac{M\,d\,s}{E\,I}$$

$\theta\,x$ being negligible compared with $d\,s$.

If only this short length of the arch is subjected to bending and the end towards A is supposed to remain fixed, the effect of the bending will be to deflect the end B to a position E, the angle B C E being equal to $\theta-\theta_1$, and therefore equal to $\frac{M\,d\,s}{E\,I}$. As this angle is extremely small, the angle C B E is practically a

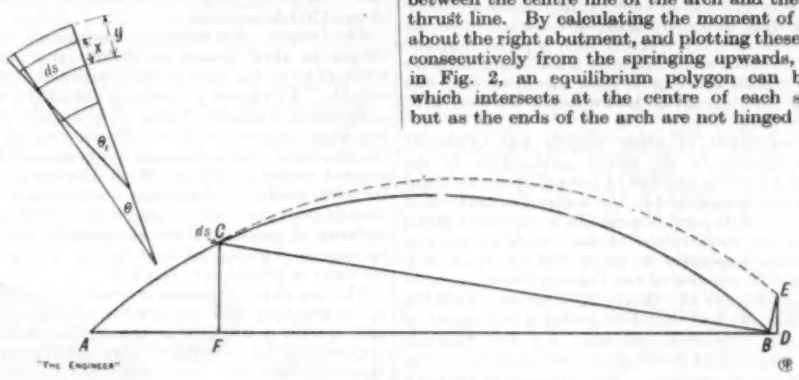


FIG. 1

right angle, and the triangle C F B is similar to the triangle B D E.

Therefore $$\frac{C\,F}{C\,B}=\frac{B\,D}{B\,E}$$

or $$B\,D=\frac{B\,E}{C\,B}\times C\,F$$

$$=(\theta-\theta_1)\,C\,F$$

$$=\frac{M\,d\,s}{E\,I}\cdot C\,F \quad . \quad . \quad . \quad . \quad (1)$$

Also $$\frac{F\,B}{C\,B}=\frac{D\,E}{B\,E}$$

or $$D\,E=\frac{B\,E}{C\,B}\times F\,B$$

$$=\frac{M\,d\,s}{E\,I}\cdot F\,B \quad . \quad . \quad . \quad . \quad (2)$$

In the fixed end arch with rigid abutments the ends are incapable of lateral or vertical movement, and therefore the sum of the quantities B D given by equation (1) is equal to zero, and the sum of the quantities D E given by equation (2) is also equal to zero. The bending of the short section $d\,s$ is represented by $\theta-\theta_1=\frac{M\,d\,s}{E\,I}$, and as the tangents at the ends of a fixed end arch remain unchanged, however the arch may be deformed due to bending, the sum of these quantities is likewise equal to zero.

These three conditions will now be applied to determine the resultant thrust line in the arch indicated in Fig. 2. As space will not allow of a larger scale being used, the centre line of the arch ring has been divided into ten equal parts, but in actual practice it would be preferable to draw the arch to a scale of not less than 4ft. or 5ft. to the inch, and to divide the centre line into twenty equal parts. The loads shown on the diagram which correspond to 1ft. width of the arch, are assumed to be applied at the centre of each of the ten divisions. As the arch is of uniform thickness, the only variable quantity in the expression $\frac{M\,d\,s}{E\,I}$ is the bending moment M, which is equal to the horizontal thrust H multiplied by the vertical distance between the centre line of the arch and the resultant thrust line. By calculating the moment of each load about the right abutment, and plotting these moments consecutively from the springing upwards, as shown in Fig. 2, an equilibrium polygon can be drawn, which intersects at the centre of each springing; but as the ends of the arch are not hinged but fixed, the resultant thrust line may intersect the verticals drawn through the centres of the springings above or below these centres. Let these vertical distances above or below the centres of the springings be y at the left abutment and y_1 at the right abutment, distances above the level of the springing being considered positive and distances below this level negative. The ordinates of the resultant thrust line are obtained by dividing the ordinates of the equilibrium polygon, measured from the base line which closes the polygon, by the horizontal thrust H. The respective ordinates of the equilibrium polygon are not altered whether the closure line at the base be horizontal or inclined, and as the calculation depends on small differences between the ordinates of the resultant thrust line and the ordinates of the centre line of the arch, the ordinates of the equilibrium polygon have been calculated for each division by taking moments of all the forces to the left of that division, having previously determined the vertical reaction at the left abutment for a two-hinged arch or simple beam subjected to the same loading, by dividing the sum of the moments of all the loads with reference to the right abutment by the span, *i.e.*, 515 foot-tons ÷ 42ft. = 12·25 tons.

The expressions which follow represent the vertical distances between the resultant thrust line and the centre line of the arch for each of the ten divisions commencing from the left, and the sum of these expressions is zero.

$$y-\frac{1\cdot7}{42}(y-y_1)+\frac{20\cdot8}{H}-1\cdot55$$

$$y-\frac{5\cdot5}{42}(y-y_1)+\frac{54\cdot8}{H}-4\cdot23$$

$$y-\frac{9\cdot7}{42}(y-y_1)+\frac{79\cdot8}{H}-6\cdot30$$

$$y-\frac{14\cdot1}{42}(y-y_1)+\frac{94\cdot5}{H}-7\cdot70$$

$$y-\frac{18\cdot7}{42}(y-y_1)+\frac{99\cdot0}{H}-8\cdot41$$

$$y-\frac{23\cdot3}{42}(y-y_1)+\frac{93\cdot0}{H}-8\cdot41$$

$$y-\frac{27\cdot9}{42}(y-y_1)+\frac{82\cdot2}{H}-7\cdot70$$

$$y-\frac{32\cdot3}{42}(y-y_1)+\frac{66\cdot2}{H}-6\cdot30$$

$$y-\frac{36\cdot5}{42}(y-y_1)+\frac{44\cdot1}{H}-4\cdot23$$

$$y-\frac{40\cdot3}{42}(y-y_1)+\frac{16\cdot6}{H}-1\cdot55$$

$$10\,y-5\,(y-y_1)+\frac{651\cdot0}{H}-56\cdot38=0$$

or $$y+y_1+\frac{130\cdot2}{H}=11\cdot28 \quad . \quad . \quad . \quad (3)$$

The sum of these expressions, each multiplied by the respective distance from the left abutment, is also equal to zero and the results are as follows :—

$$1\cdot7\,y-\frac{1\cdot7^2}{42}(y-y_1)+\frac{35}{H}-2\cdot6$$

$$5\cdot5\,y-\frac{5\cdot5^2}{42}(y-y_1)+\frac{301}{H}-23\cdot3$$

$$9\cdot7\,y-\frac{9\cdot7^2}{42}(y-y_1)+\frac{774}{H}-61\cdot1$$

$$14\cdot1\,y-\frac{14\cdot1^2}{42}(y-y_1)+\frac{1332}{H}-108\cdot6$$

$$18\cdot7\,y-\frac{18\cdot7^2}{42}(y-y_1)+\frac{1851}{H}-157\cdot2$$

$$23\cdot3\,y-\frac{23\cdot3^2}{42}(y-y_1)+\frac{2167}{H}-196\cdot0$$

$$27\cdot9\,y-\frac{27\cdot9^2}{42}(y-y_1)+\frac{2294}{H}-214\cdot8$$

$$32\cdot3\,y-\frac{32\cdot3^2}{42}(y-y_1)+\frac{2138}{H}-203\cdot5$$

$$36\cdot5\,y-\frac{36\cdot5^2}{42}(y-y_1)+\frac{1610}{H}-154\cdot4$$

$$40\cdot3\,y-\frac{40\cdot3^2}{42}(y-y_1)+\frac{669}{H}-62\cdot4$$

$$210\,y-\frac{5996}{42}(y-y_1)+\frac{13,171}{H}-1183\cdot9=0$$

or $$67\cdot2\,y+142\cdot8\,y_1+\frac{13,171}{H}=1183\cdot9 \quad . \quad . \quad (4)$$

The sum of the numerical coefficients in the first column is equal to five times the span.

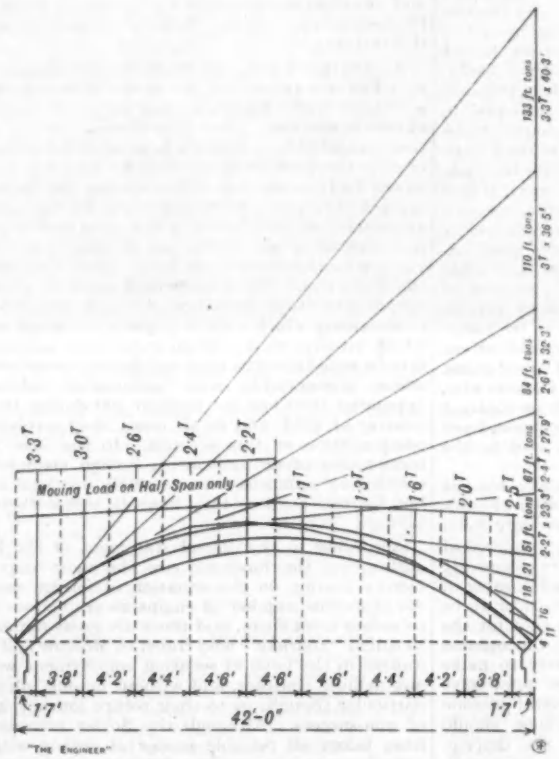


FIG. 2

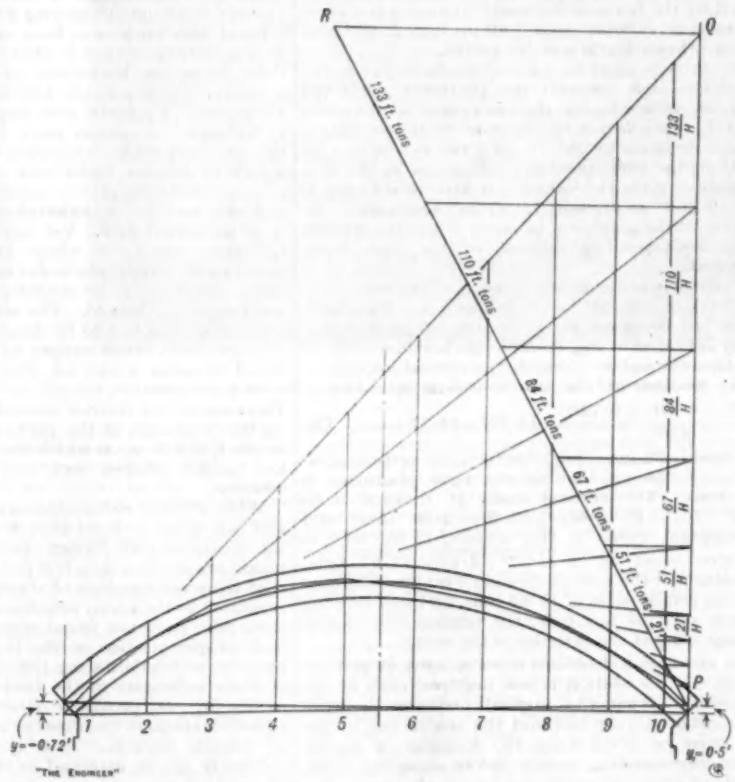


FIG. 3

The values of the squares in the second column are taken from tables and the products figuring in the third and fourth columns are worked out using four-figure logarithms. As the same numbers occur two or three times in the various calculations, by working systematically the apparently laborious operations are very much simplified.

The sum of the original expressions, each multiplied by the respective ordinate of the centre line of the arch, is also equal to zero and results as follows :—

$$1{\cdot}55\,y - \frac{2{\cdot}6}{42}(y-y_1) + \frac{32}{H} - 2{\cdot}4$$

$$4{\cdot}23\,y - \frac{23{\cdot}3}{42}(y-y_1) + \frac{232}{H} - 17{\cdot}9$$

$$6{\cdot}30\,y - \frac{61{\cdot}1}{42}(y-y_1) + \frac{503}{H} - 39{\cdot}7$$

$$7{\cdot}70\,y - \frac{108{\cdot}6}{42}(y-y_1) + \frac{728}{H} - 59{\cdot}3$$

$$8{\cdot}41\,y - \frac{157{\cdot}2}{42}(y-y_1) + \frac{833}{H} - 70{\cdot}7$$

$$8{\cdot}41\,y - \frac{196{\cdot}0}{42}(y-y_1) + \frac{782}{H} - 70{\cdot}7$$

$$7{\cdot}70\,y - \frac{214{\cdot}8}{42}(y-y_1) + \frac{633}{H} - 59{\cdot}3$$

$$6{\cdot}30\,y - \frac{203{\cdot}5}{42}(y-y_1) + \frac{417}{H} - 39{\cdot}7$$

$$4{\cdot}23\,y - \frac{154{\cdot}4}{42}(y-y_1) + \frac{187}{H} - 17{\cdot}9$$

$$1{\cdot}55\,y - \frac{62{\cdot}4}{42}(y-y_1) + \frac{25}{H} - 2{\cdot}4$$

$$56{\cdot}38\,y - 28{\cdot}19\,(y-y_1) + \frac{4372}{H} - 380{\cdot}0 = 0,$$

or
$$28{\cdot}19\,y + 28{\cdot}19\,y_1 + \frac{4372}{H} = 380 \quad . \quad . \quad (5)$$

These three equations—(3), (4) and (5) determine the values :

$$H = 11{\cdot}32 \text{ tons}$$
$$y = -0{\cdot}72\text{ft.}$$
$$y_1 = 0{\cdot}50\text{ft.}$$

The resultant thrust line can now be drawn following the procedure indicated in Fig. 3. The value of $y = -0{\cdot}72$ft. is set off below the centre of the left springing, and the value of $y_1 = 0{\cdot}50$ft., above the centre of the right springing. From this point and vertically upwards, the values of the moments of each of the loads about the right abutment, divided by the horizontal thrust, are consecutively set off. This can be done graphically as follows :—The sum of the moments of all the loads with reference to the right abutment is 515 foot-tons, which, divided by the horizontal thrust, 11·32 tons, gives 45·4ft. This distance P Q is set up vertically on the right abutment to the same scale as the drawing of the arch, starting from the point determined by $y_1 = 0{\cdot}50$ft. At Q a horizontal line Q R is drawn. The value 515 foot-tons is set off to a convenient scale on a diagonal line P R, and on this line the respective moments of each of the loads are plotted. By drawing horizontal lines through the points thus determined, the distance P Q is divided up into parts representing each moment divided by the horizontal thrust. By using the same construction as that employed in Fig. 2, the true resultant thrust line is now completed.

The absolute maximum deviations from the centre line of the arch occur at the abutments, and the maximum values within the span occur at divisions 4 and 7. Calculating the amount of the deviation at these divisions by substituting the values of y, y_1 and H in the corresponding expressions in the first summation, gives the values $+0{\cdot}34$ft. at division 4, and $-0{\cdot}35$ft. at division 7. From these values the accuracy of the graph can be checked and the stresses in the corresponding sections of the arch truly calculated.

At division 7, for instance, the bending moment is $11{\cdot}32 \text{ tons} \times -0{\cdot}35\text{ft.} = -3{\cdot}96$ foot-tons. The direction of the resultant thrust on the left abutment is clearly indicated in Fig. 3, and as the horizontal thrust is uniform throughout the arch, the vertical component of the reaction at the left abutment is evidently $\frac{45{\cdot}4\text{ft.} + 0{\cdot}5\text{ft.} + 0{\cdot}72\text{ft.}}{42\text{ft.}} \times 11{\cdot}32^{\text{T}} = 12{\cdot}57$ tons. The total load is 22 tons and, therefore, the vertical component of the reaction at the right abutment is 9·43 tons. The vertical shear at division 7 is $(9{\cdot}43^{\text{T}} - 2{\cdot}5^{\text{T}} - 2^{\text{T}} - 1{\cdot}6^{\text{T}} - \frac{1}{2} \times 1{\cdot}3^{\text{T}}) = 2{\cdot}68$ tons, and the resultant thrust at this division of the arch is therefore equal to $\sqrt{11{\cdot}32^2 + 2{\cdot}68^2} = 11{\cdot}63$ tons. The section of the arch at division 7 is thus subjected to direct compression of 11·63 tons, and to a bending moment of 3·96 foot-tons, the tension due to this bending being at the extrados of the arch.

The calculation described is for an arch of uniform section. If the section is not uniform, each of the expressions giving the vertical distances between the resultant thrust line and the centre line of the arch must be divided by the moment of inertia of the corresponding section before summing them, and these corrected expressions must also be used in proceeding to the second and third summations.

The Position of the Foreign Engineer in U.S.S.R.

THE SOVIET REPLY TO CRITICISMS.

(By a Correspondent.)

IT is generally known that the number of foreign engineers and specialists working in U.S.S.R. has reached very large figures during the last two years, and although German and American workers predominate, there are now large numbers of English engineers engaged at many of the new plants that are being erected. During the present year a considerable amount of anxiety has been displayed in Germany as to the treatment of the foreign workers who have accepted service there in view of the reports as to the hardships that many of them were undergoing. In fact, matters recently reached such a pitch that the German Association of Machine Tool Manufacturers issued an official warning to their members as to the conditions that should be laid down when men were sent to U.S.S.R.

The publication of these details has evidently caused uneasiness to the Soviet authorities, as the services of a certain number of foreign specialists and key workers are essential to the successful working of the Five-year Plan, and it would be a matter of grave concern if the recruitment of such workers were to become more expensive or more difficult than it is at present. A member of the Foreign Department of the Commission for the Heavy Engineering Industry (M. Vladimirow) has therefore issued a statement of the position intended primarily for the German industry, which is interesting both for what it conveys and for what it implies. This statement may be summarised as follows :—

Articles and correspondence have recently appeared in the foreign Press (states M. Vladimirow) concerning the position of foreign workers and specialists in U.S.S.R., from which it might at first sight be inferred that there is in progress an organised campaign against such workers. The number of foreigners engaged in the heavy engineering industry in the U.S.S.R. is steadily growing, and has now reached a figure of some 6800 persons ; moreover, there is not the slightest doubt that this number would quickly reach 10,000 if it were possible to provide suitable dwellings. The number of foreign specialists who, in consequence of the expiration of their contracts or on other grounds, are leaving the country forms only a small percentage of this total. The material living conditions of the foreign workers are with a few isolated exceptions satisfactory, and in the majority of cases very satisfactory indeed.

This influx of foreign specialists has now been going on for a couple of years, the majority of the newcomers being qualified engineers and skilled workers acquainted with the technique of large-scale production, and prepared to impart their experience. Both in official documents and in the field of practical work it is freely recognised that foreign workers have rendered important services in many fields of work connected with the installation, the organisation, and the production of many Soviet undertakings, and many such workers have secured awards on account of the work they have rendered.

Apart from this type of worker, however, there is a small but exceedingly vocal adventurer element. These, though only possessing a very superficial knowledge of their profession, have aspired to play the *rôle* of first-class specialists in what doubtless appeared to them to be the backwoods of a prehistoric Soviet industry. Such persons deceived themselves badly. They came to gigantic new works, which in size and in technical equipment have certainly no equal in Europe and hardly in America, and it is hardly to be wondered at that under such conditions their very poor qualifications proved unsatisfactory for the task, and in a number of undertakings their services had to be dispensed with. Yet another group of pseudo-specialists are those whose knowledge was either inadequate for their particular task or whose qualifications turned out to be considerably lower than what was originally claimed. The services of a number of these have also had to be dispensed with by various managements, while others have had to be transferred to other works for which their qualifications were more suitable, though naturally at lower rates. There are certain further cases of foreign workers who, on the conclusion of the particular work or contract in the U.S.S.R. upon which they were engaged, have lost further interest both in the work and in the country.

When all these circumstances are taken into account and it is borne in mind that in the majority of cases the contracts with foreign specialists are only for a maximum of two years, it is hardly to be wondered at that there are numbers of these engineers constantly returning to their own countries. A small number of those who have not found what they consider to be their proper position in the U.S.S.R., either for the purpose of rehabilitating themselves in the opinion of their colleagues in the trade or merely to make money by the provision of sensational news have raised an alarm in the Press as to the general position of foreign workers. Too much credence should obviously not be attached to stories of this description, but it is a pity when they serve to deter well-qualified foreign engineers and workers who would like to work in U.S.S.R (and whose services the Soviet authorities would like to secure) from making the journey and undertaking a period of interesting work. In general, however, in spite of the outcry of those who have not succeeded in establishing themselves satisfactorily, the interest of foreign workers in the country and the Five-year Plan is growing, and during the last two years the total number of applications received by the Commission for the Heavy Engineering Industry and the foreign Soviet organisations from foreigners desirous of working in U.S.S.R. has reached a total of approximately one million. Against this number of applications the total number of foreign workers so far engaged in the engineering industry (as already stated) amounts to some 6800 persons, of which 2300 are specialists and 4500 workmen. Of these, 3300 are of German nationality and about 1700 Americans.

The Soviet organisations endeavour by all the means in their power to ensure that the foreign workers have the best living conditions that are procurable. In regard to housing conditions especially, although it is admitted that they are not everywhere the same, nevertheless in consequence of the great development of the housing programme they are in general equal to normal West European conditions for such workers. Incoming workers in U.S.S.R. are usually provided with goods on special terms, and the delivery of goods to them at specially low prices has become so widespread that hardly anyone exercises his right of purchase to the full.

The system of payment in vogue in U.S.S.R., taken in conjunction with the graduated scale of increases give qualified workers in the leading industries the opportunity of securing a very satisfactory income. Wages of 300, 400, 500 roubles per month and more are general. Salaries of specialists are in most cases even higher. Foreign workers moreover enjoy all the rights of trade union members in the U.S.S.R. in regard to holidays with full pay, special insurance, free medical attendance, &c., and these benefits, combined with the two-year and three-year contracts, serve to form an attractive basis for the further recruitment of foreign workers in the engineering industry.

It is, of course, natural that the Soviet undertakings working on an economic basis wish to achieve their stipulated programme of production with a minimum of expenditure, especially in regard to foreign currency, as far as this can be done without prejudice to the workers. The different works requiring to obtain highly qualified specialists and workers from abroad therefore prefer to pay them in Soviet currency, and it is only in exceptional cases that they will now agree to pay a portion of the salary in foreign currency, although in the initial stages of the Five-year Plan this used to be very usual. Such works therefore are now allowing to lapse those contracts which necessitate any considerable payments in foreign money on account of wages. Naturally, also, the works are endeavouring to avoid unproductive expenditure, especially in those cases where the qualifications of the individual foreign workers have not proved to be good value for the money that is being paid. It should here be mentioned in connection with workers' qualifications that when notice of termination or revision of a contract is given the decision of the management of the Soviet undertaking is subject to the right of appeal to the workers' unions, and especially to the legal section of the engineering and technical workers, and to the courts, which have frequently conceded the claims of foreign workers in this respect.

A situation sometimes arises when a management may find it necessary to give notice of termination of a contract with a foreign worker before the expiration of such agreement. The rights of the latter are in this case protected by a special clause whereby in the case of early termination by the Soviet authorities not due to any fault on the part of the worker, the former are compelled to pay a parting gratuity for the time the agreement has still to run, or not more than a month, but sometimes two, and to pay the cost of the return journey for the workman and his family. Occasionally the worker and the management come to a mutual agreement as to an alteration in regard to that portion of the salary which may be payable in foreign money which involves no alteration in the total amount. It is to be noted that the total number of foreign workers whose engagements were terminated before the appointed time has not reached 200 during the first quarter of 1932, and in all cases they received full compensation on this account. In the case of the termination of an agreement, foreign engineers are entitled to sufficient time to settle up their affairs, but for this purpose they have to utilise their own savings.

According to the official statement of the Soviet authorities, the foregoing are the most important factors bearing on the situation of foreign workers. An enormous number of engineers are endeavouring to secure work there, and there are great numbers of so-called "tourists" who travel to Moscow and other centres in the hope of securing employment without any definite contract, and without having taken any particular thought as to their return journey in case of non-success. Although the Soviet organisations have taken all possible means of coping with the situation set up by tourists of this kind, it is necessary that workers should observe the regulations on

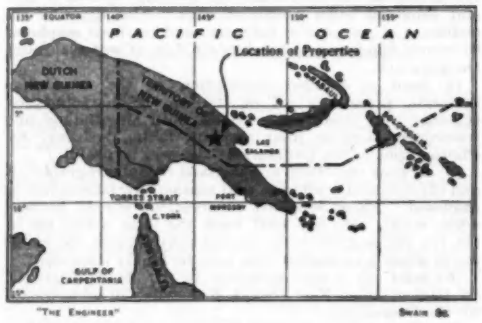
account of the difficulty of securing accommodation. There exists almost unbounded opportunities of work in the U.S.S.R., but considering existing needs in the way of living accommodation the recruitment of foreign workers can only be carried out by those undertakings which are themselves in a position to provide the necessary living accommodation.

Air-Transportation of Gold Dredges in New Guinea.*

By CHARLES A. BANKS.

The development, in 1929, of a large volume of dredgeable gold-bearing gravel, in the Mandated Territory of New Guinea, brought the directors of Placer Development, Ltd., the exploration company which had proved the area and wished to equip it, face to face with an unusually difficult transportation problem.

The dredging property consisted of a stretch of 4½ miles of the Bulolo River-bed and flats, situated approximately 7 deg. south of the Equator, at an elevation of 2250ft. above sea-level, and 35 miles, in a direct line, from the coast. The proved ground averaged about 2000ft. in width, while the average depth of the gravel was 22ft. The Bulolo River, which runs throughout the length of



SITUATION OF BULOLO DREDGING GROUND

the property, is about 200ft. wide, and carries from 250 cubic feet to 300 cubic feet of water per second in the dry spells, and up to perhaps twice that amount at other times.

The dredging ground was covered with heavy tropical jungle, and fortunately there existed a number of magnificent cedar trees, which later supplied excellent construction lumber.

The valuation of the property, based on drilling and shafting, set the volume of dredgeable ground at 40,000,000 cubic yards and the average recoverable gold content at 50 c. per cubic yard. The gold, which is approximately 650 fine, is contained throughout the depth of the gravel with a concentration of values towards the bottom. These gold-bearing gravels are the erosion product of a gold quartz-vein area situated about 12 miles further upstream, and at several thousand feet higher elevation.

The gravel was found to contain a number of fairly large boulders, particularly in the upper portion of the deposit, though nothing was encountered in the shafting which a dredge of 10 cubic feet bucket capacity would be unable to handle. In spite of the presence of these boulders the gravel was considered as being particularly easy digging ground, and, further, remarkably free from clay. The "bedrock" consisted of soft blue clay, giving a very satisfactory dredging bottom.

For the purpose of equipping the property with two all-steel bucket dredges, each of 10 cubic feet bucket capacity, and of harnessing the Bulolo River, at the upper end of the property, for supplying several thousands of electrical horse-power for driving these dredges, Placer Development, Ltd., formed, in the early part of 1930, an operating company named Bulolo Gold Dredging, Ltd.

Recently Bulolo Gold Dredging, Ltd., absorbed an additional volume of approximately 60,000,000 yards of gravel of an estimated gold content of roughly 30 c. per yard, situated on the Bulolo and Watut rivers, immediately downstream from the original Bulolo area. As no road whatever existed from the coast to the property, the all-important question of transportation had now to be settled—on this hinged the success of the whole undertaking. The construction of a road was carefully considered and trial surveys were made. It was found, however, that to cross an intervening range of mountains, the lowest pass through which was roughly 4000ft., the road would have been over 90 miles in length, would have taken from a year to a year and a-half to build, and cost approximately a million dollars. Further, the building of a road, and the acquisition of suitable hauling equipment, would not necessarily have overcome the transportation question, for road maintenance in a tropical country such as New Guinea, with its sudden heavy rainfalls, and its abundant tropical growth, was quite an unknown quantity.

Was there any alternative? Time was an important factor, as it always is where large potential profits are waiting to be won.

During the testing of the ground, communication with the coast had been maintained by a local air transportation company—Guinea Airways, Ltd.—and the whole of the equipment and the general supplies for the testing had been safely taken to the field by this company's aeroplanes, which carried up to 2000 lb. per trip.

Was it possible to air-transport large steel dredges, and a hydro-electric plant of several thousand horse-power? Air transport on such a scale had never been attempted. Could the weights and dimensions of the equipment be sectionalised to aeroplane requirements? If so, would the cost of such sectionalising and the extra cost of field erection be excessive, and, if not, was the capital cost of suitable aeroplanes, and the cost of operating them, to count it out? And further, if not, was the risk too great? The loss of a critical piece might set everything back months, and it was even conceivable that a run of bad luck might kill the whole enterprise.

All these were questions requiring the most careful consideration. The writer conferred with Mr. Frank Griffin, of San Francisco, a co-director who was to be responsible for the design of the dredges, and obtained details of the critical parts, both as to weight and size, that would require to be air-transported to the field. The Junker Aeroplane Manufacturing Company considered that it could adapt its standard tri-motored G-31 passenger plane to provide a suitable-sized cargo cabin or compartment, and, for the short distance over which we wished to transport the machinery, to make it capable of carrying up to 7000 lb. of freight. It also decided that a large hatch could be provided in the roof of the cargo cabin, so as to allow of the aeroplane being loaded by crane. A model of the cargo compartment was then made and models of all the critical parts which had to be carried were loaded into the model cargo compartment, particular care being taken to see that such pieces as approximated the capacity of the plane, such as the upper tumbler shaft, which weighed 7000 lb., were capable of being loaded over the centre of gravity of the machine, which was situated almost directly under the hatchway and about 6ft. from the front of the cargo compartment. With a few alterations in the then contemplated design of the critical parts and some further slight alterations to the cargo compartment, it was apparent that the aeroplane could be made to suit the requirements.

Further, it was soon realised that the cost of sectionalising, and the extra cost of erection in the field, would not be excessive, and still further, that, with proper precautions, the risk of losing parts was really very slight.

In December, 1929, it was decided to abandon all idea of a road, and to air-transport the whole of the machinery and equipment from the coast to the site of erection in the field. The total weight of machinery and equipment to be carried for the two dredges and the hydro-electric plant was estimated at 2400 short tons, and, in order not to delay construction, it was figured that 200 tons monthly would be required to be carried.

Two Junker G-31 aeroplanes were acquired, and transportation of the machinery from the coast to the field commenced in April, 1931, and, for the twelve months, to the end of March, 1932, a total of 2500 short tons, comprising the whole of the above-mentioned equipment, had been safely transported by these two planes, and without a single accident. The tonnage was steadily built up from 35 tons in April, 1931, to 350 tons per month later on, when the staff became better organised and more accustomed to loading the machines, and as the weather conditions improved.

Junker aeroplanes were considered the most suitable, as, first, being all metal in construction, they saved the very heavy cost of constructing hangars in New Guinea, and secondly, these machines were particularly suitable for heavy freighting, for, being of the low-winged type, the heavy weights could be crane-loaded through a hatch directly on to the cabin floor, which was rendered particularly strong by the fact that the strong wing section ran underneath, and formed part of, this floor.

The cargo compartment of the machine was 24ft. long, 77in. wide and 69in. high, while the hatchway was 142in. in length by 60in. wide. The hatch was provided with a concave cover, so as to give an additional 12in. of head room below the hatchway, and directly over the centre of gravity, where the largest pieces were to be carried. The interior of the cargo compartment was free of obstructions, excepting two sets of stays, placed approximately 12ft. and 18ft. from the front of the compartment. These stays, which reduced the floor width to 31in., angled back to meet the sides of the compartment at their junction with the roof. A side door was provided close to the rear for loading small material, and as a means of entering the cabin.

TUMBLER SHAFT LOADED FOR TRANSPORT

The Junker G-31 aeroplane has a pay load of 5800 lb., allowing for a crew of two, and sufficient petrol for 3½ hours' flight. The average flying time from the coast (Lae) to the Bulolo dredging area and return, being only 75 minutes, a reduction in the petrol load could be made to allow of the carrying, with two pilots, of 7000 lb. of cargo, while at the same time retaining ample reserve of petrol.

Sufficient power was provided, in order that the fully loaded aeroplanes could be sustained in flight with any two engines—in the test flights these planes, at an altitude up to 3000ft., actually climbed at the rate of 200ft. per minute on two engines and under full load. This margin of power was a great insurance against forced landing and loss of life, material and time. The reserve of power was also of great importance in this particular case, as, with high mountains to cross, a fast rate of climb was important. Under normal working conditions the aeroplanes would climb to 7000ft. in thirty-five minutes with three-quarter throttle. The average height attained in crossing the mountain was 6000ft., while the useful ceiling of the machine is approximately 12,000ft.

The flying distance from the coast air port (Lae) to Bulolo and return is 100 miles, and the average flying time for the return trip is seventy-five minutes. Over short distances such as this speed is not very essential, though it would be a factor in greater distances. The landing speed of the planes is approximately 75 miles per hour. This is rather high and, while compressed air brakes are fitted to check the run on landing, long aerodromes are required. The take-off distance of the planes is short on account of the reserve engine power. A quick take-off and a low landing speed greatly reduce the risk of accidents due to errors in judgment. An aerodrome 1000 yards by 1000 yards would be of sufficient size to allow of the landing of the planes in any direction. Actually both the Lae and

CLEARING SITE FOR AERODROME AT BULOLO

AERIAL VIEW OF ONE DREDGE AND PART OF AERODROME

* Abstract of paper read before the Institution of Mining and Metallurgy, July 20th.

the Bulolo aerodromes, while each being upwards of 1000 yards in length, are not more than about 500 yards in width. This, however, is quite satisfactory, for the planes are always landed against the wind, and quite 99 per cent. of the wind at Lae blows from either end of the aerodrome, while at Bulolo over 90 per cent. blows up and down the aerodrome.

At the outset it was a question as to whether the port of Salamoa or that of Lae should be used, as the flying base. Lae, which was already being used by Guinea Airways, was finally decided upon, and early in 1930 a commencement was made on its further development. Lae is more or less an open roadstead, but with care no difficulty is experienced in lightering cargo from the ocean vessels which come to within about a quarter of a mile of the shore. A wharf was erected and a broad-gauge railway, three-quarters of a mile in length, was laid from the wharf to the existing Government aerodrome. Two 100-ton steel barges and a steam lighter were acquired for landing the cargo from the ship's side to the pier. A 10-ton locomotive crane transferred the equipment to trucks, and the same crane loaded it into the aeroplanes. The Government aerodrome at Lae was lengthened, and was generally made more suitable for the large aeroplanes which it would now have to serve, and storehouses, workshops, and white and native quarters were built to house the pilots, mechanics, and the native labour which was to be used for handling the equipment and servicing the aeroplanes. Further, a suitable concrete loading apron with petrol pumps was built. Due to the fact that the Lae aerodrome had little or no grade, and also on account of the very heavy rainfall at the coast, this aerodrome has never been very satisfactory, and at times it has caused a good deal of anxiety. It is hoped that a system of deep drainage, which is now in hand, will improve matters and make the ground safe for the landing of the heavy freight planes at any season of the year.

The construction of a suitable aerodrome at Bulolo was quite a major undertaking, and it involved many months of work with large gangs of natives under white foremen. A sandy gravel site was chosen at the downstream end of the property, and just off the dredging area. The dense tropical jungle, with trees up to 4ft. in diameter, was cleared for a length of roughly 4000ft. by 1500ft. in width, and all trees were cleared away from the end boundaries for a distance of 500 yards. After the aerodrome area was cleared and all stumps removed the ground was graded so as to make the surface as uniform as possible. Fortunately, the site had a natural and gentle slope to the river, and this, with a large drain which was run on the top side, kept it free of surface water and generally well drained.

While the surface of the aerodrome was bare, the reflected heat of the sun gave the pilots some difficulty in keeping their machines at the correct altitude when landing. To overcome this the whole area was planted with "couch" grass. This grass took well and very rapidly spread and grew into a compact carpet about 12in. thick. Continual cutting will cause the grass to develop a deep root system and bind the surface very effectively. The Bulolo aerodrome took seven months to complete, and cost approximately 30,000 dollars. It is an excellent ground and, since its completion, the only maintenance has consisted of keeping the grass cut. The planes weigh approximately 19,000 lb. fully loaded, and the tires are inflated to 65 lb. per square inch. The continual landing of these heavy planes at 75 miles per hour has had little or no cutting effect on the surface of the Bulolo aerodrome.

The loading and unloading of heavy awkward parts of machinery need careful attention, but in spite of all care the hatchway and the sides and floor of the cargo compartment come in for an odd bump now and again and so, after a while, the cabin shows signs of wear. Should any part of the cabin be badly damaged it can, of course, be cut away and replaced with spare material which is always kept on hand for repairing the body of the plane. To the end of March, 1932, each of the aeroplanes had completed approximately 625 hours of flying and, in the absence of a total loss by accident, it is probable that they will each be good for a further, say, 3000 hours' flying.

After the planes had been in use for a short time the landing wheels commenced to collapse. This was brought about by the heat which was generated by the brake operating on the rim of the wheel, expanding the rim until it burst. Luckily no serious damage was done. The result was usually a rather dangerous swing just before the machine was brought to a standstill, and a worthless wheel, tire, and tube. The design of the wheels was changed and since then no difficulty has been experienced.

The aeroplanes are each fitted with three 525 H.P. direct drive nine-cylinder radial air-cooled Hornet engines, making a total of 1575 H.P. per plane. This gives a low-power loading of just over 12 lb. per horse-power, which accounts, in a measure, for the quick take-off and rapid climb of the machines. Three spare engines were acquired and a liberal supply of engine spare parts. The engines are run for about 200 hours before being removed from the plane for overhauling. Though only a "top overhaul" is then required, complete overhauls have always been made, as the extra cost and time incurred is more than offset by removing as far as possible the chance of engine failure from mechanical cause. While the life of an engine can be figured at about 2000 hours, it is usually possible for the makers to recondition the engine with certain over and undersize parts and then to start it off on a second 2000 hours.

At the Lae aerodrome the concrete loading apron was fitted with platform scales for weighing the tail of the plane. The aeroplane taxis on to this platform, always from the same end so that it will be in the correct position as regards the scales and fuelling plant, and the locomotive type loading crane then moves into its position just behind the wing for loading. The cargo is always loaded and unloaded from the rear, so that in case of accident the load falls on the back and more easily repaired part of the fuselage instead of on the wing or front portion. If the cargo has been correctly loaded the weight of the tail should be between 1800 lb. and 2200 lb. Should the weight be found to be above or below this amount, part of the cargo is adjusted forward or backward until the tail weight is within the required limits.

For the reason that the aeroplane was designed to carry long pieces, as well as heavy pieces, it is impossible to fly the machines empty, so that ballast has to be placed in the aft compartment in order to bring the tail weight up to the required 2000 lb. or thereabouts on the return journey from Bulolo to Lae. Water ballast could be satisfactorily used, but as gravel was handy at Bulolo and was an asset at the loading platform at Lae, gravel in bags was used for this purpose.

The average load carried was 5400 lb., but when the Lae aerodrome is better drained, and its surface generally improved, there is no reason why this should not be increased to around 6000 lb., or even more. The greatest number of flights made in any one day, with one machine, was five. Under ideal weather conditions, five trips per plane could be made daily from Lae to Bulolo; with an average load of 3 tons per trip, this would mean the transportation of 900 short tons per 30-day month. To have made a single round trip by road from Lae to Bulolo would, no doubt, have taken a tractor at least a week—had a road existed.

Flying was not attempted when the weather conditions were at all unsatisfactory. In order to reduce as far as possible the weather hazard, two wireless telephone stations were established, one at Lae and the other at Bulolo. While, on account of the topography of the country and perhaps also the climate, this service was not entirely satisfactory, it aided the flying to a considerable extent. Pilots were able to leave Lae in the early morning, as soon as the Bulolo valley was reported by wireless as being clear of fog, and, further, machines could be held at Bulolo should the weather conditions at Lae suddenly become unsettled.

Throughout the transportation of the whole 2500 tons, necessitating approximately 1000 trips, engine trouble developed during one flight only. On this occasion the centre engine failed, due to installation trouble, and the loaded plane finished the flight, without difficulty, on the remaining two engines.

The total capital outlay for the aeronautical equipment and plant, plus the cost of operating the planes for the transportation of 2500 short tons, but excluding amortisation of equipment and plant, was, roundly, 550,000 dollars, plus 182,000 dollars, or 732,000 dollars. In comparing "air" with "road" transportation, it is perhaps fair to add to this figure of 732,000 dollars the cost of sectionalising the dredges, and the extra cost of field erection. Mr. Griffin estimates the total extra cost of sectionalising the two dredges at 10,000 dollars, and the total extra cost of field erection at 20,000 dollars, making 30,000 dollars in all. This, then, increases the above cost to 762,000 dollars.

Comparing the cost of road transport with the above, it is only possible to make a rough guess at what would have been the position had road transportation been adopted. To the estimated cost of 1,000,000 dollars for road construction has to be added, say, 75,000 dollars for hauling equipment and road house accommodation, together with, say, 125,000 dollars to cover the actual cost of transporting the equipment over the road and of maintaining the road. This is a total outlay of, say, 1,200,000 dollars as against, say, 762,000 dollars which has been expended in connection with the delivery of the equipment to Bulolo by air. There is still a further and very important benefit which has accrued to us from the air transportation. At least one year has been saved in time, and, with a tentative profit of something over 20,000,000 dollars in the Bulolo area, including the additional yardage recently acquired, the saving in interest at 5 per cent. by the earlier winning of this profit, is more than sufficient to pay the entire cost of the aeroplanes and the handling of the whole of the equipment for four dredges and the power plant from the ship's side to the site of erection at Bulolo.

You will probably say that in one case, when the equipment was in, we would have had a road to the coast, whereas in the other case all we have is our aeroplanes. This is true, but, in tropical New Guinea, we feel that the aeroplanes will probably be more satisfactory as a permanent connection to the coast than a road, and will cost less to maintain.

Hydrostatic Pressure Within and Under Dams.

WE have been requested to publish the following open letter addressed to engineers in all parts of the world :—

The Committee on Dams of the American Society of Civil Engineers is making a study of hydrostatic pressure both within and under the bases of dams. In this connection the Committee invites the co-operation of engineers in every country who are designing or constructing dams.

The Committee desires facts as noted by careful observation, and not opinions or theoretical discussions. Present knowledge regarding actual uplift under and within dams is limited. Therefore, we ask engineers, when designing a dam, to incorporate in their plans methods of observing the hydrostatic pressures which will develop when the structure goes into service. All useful information that comes to the Committee will be published for the benefit of the profession and full credit will be given to those who furnish reliable data.

Each engineer may design a method to measure uplift to suit his local conditions. The simplest installation for observing uplift is a system of pipes in which the pressure at the lower end may be measured by gauge or in a riser pipe. All pipes should be built into the dam as it is being constructed, with their lower ends open. For measuring hydrostatic uplift under the base, the pipes should terminate in suitably arranged cavities, filled with granular material, at the base of the structure. The pipes should be spaced at intervals along the length of the dam, and at each location there should be not less than three pipes in an up and downstream direction, this number increasing with the width of the base. If a rock foundation has extensive or nearly horizontal stratifications, other pipes should be carried down below the base to some of the rock joints. The locations and elevations below the base should be governed by the character of the foundation material, whether rock or soil, and the purpose should be to locate the pipes systematically in both longitudinal and transverse directions with the view to developing all possible conditions.

For measuring hydrostatic uplift within the structure, similar pipes should be arranged with their open lower end at different elevations above the base, as the design of the structure will permit. It would be well to have their lower ends open into horizontal construction joints.

The pipes may be led to one or more central observing points, as found convenient, so long as the grade is always upward. The size of the pipes is not important, but should be such as to permit observations of the water levels within them.

The cost of installing such pipes will be small when a dam is under construction, while the benefits to be derived may be very great. The public has a direct interest in the safety of dams.

We urgently request that the following procedure be carried out :—

(1) Observe the water level or water pressure in each pipe at intervals, which should be practically simultaneous for each cross section, recording also the levels of the reservoir and tail water surfaces. The observation intervals should be frequent as the reservoir is filling. Thereafter every week or every month will suffice. At least a year's observation should be recorded.

(2) Observe the temperature of the water, both in the reservoir and in the pipes. There is some evidence that uplift pressure may be affected by temperature.

(3) Send us the observations at intervals. Also drawings of the dam showing the pipe locations and necessary cross sections, all to scale. The drawings should illustrate the details of the cut-off and the drainage system if any, and show all other pertinent data. Also describe the character of concrete or masonry, and methods employed to secure bonding and to obstruct flow of water through the structure.

(4) Send a detailed description of the foundation material, presenting all of its known characteristics, together with geological sections, both longitudinal and transverse, showing joint systems, faults, bedding, &c. Photographs of the foundations also will be useful.

(5) Repeat the observations asked for in paragraphs (1) and (2) sufficiently often so that seasonal variations will be disclosed. These repeated observations should be sent when made. Do not hold back the data asked for in (1), (2), (3), and (4), as its receipt may suggest the securing of other information that may be highly important.

(6) Send all communications to H. de B. Parsons, 26, Beaver-street, New York, U.S.A., who will acknowledge for the Committee.

The Committee would be glad to correspond regarding details, should any one so desire.

COMMITTEE ON DAMS, AM. SOC. C.E.
THADDEUS MERRIMAN, Chairman.
FREDERICK H. FOWLER.
D. C. HENNY.
J. B. LIPPINCOTT.
H. DE B. PARSONS.
CHARLES B. WING.
SILAS H. WOODARD.

July 18th, 1932.

SIXTY YEARS AGO.

IN a few weeks' time a party numbering about 130 will be leaving Southampton for the Summer Meeting of the Institution of Mechanical Engineers, which this year is to be held in Canada and the United States. The itinerary will include Quebec, Montreal, Ottawa, Toronto, Hamilton, Brantford, Niagara Falls, Rochester, Schenectady, and New York, but during the whole of the fourteen clear days on the other side there will be only one paper presented for discussion, not counting a Sunday afternoon address at Niagara. We may fittingly compare and contrast this programme with that of the Institution's Summer Meeting of sixty years ago, as reported in our issue of August 2nd, 1872. The meeting of that year was held at Liverpool under the presidency of Mr. C. W. Siemens. The history of the Institution was at that time approaching a turning point. Its headquarters were still in Birmingham, in which city the Institution had been established in 1847. It was proposed that the small, temporary establishment so far occupied should be replaced by a permanent home, erected at a cost of about £12,000 out of the Institution's funds. The new headquarters were to be situated, like the old, at Birmingham, but at the Summer Meeting of 1872 it became apparent that there was a considerable body of opinion in favour of the Institution removing its home to London. Mr. Siemens referred to this subject in the opening remarks of his address from the chair. As we all now know, those in favour of London eventually won the contest. The main subject of technical interest discussed in the President's address was the supply of coal, its enhanced price, and how its consumption might be economised. Following the President, Mr. (Sir) F. J. Bramwell addressed the meeting on compound engines and high-pressure steam. His remarks gave rise to a long and apparently hot discussion, in which Mr. Crampton advanced the opinion that the limit of advantage in the use of high-pressure steam was reached at about 40 lb. per square inch. Others held that the limit lay at least at 60 lb., while still others argued that there was no theoretical or practical reason why a limit should exist at all. The rest of the day was devoted to visits to the Birkenhead Forge, Brassey and Co.'s railway bridge and locomotive works, and the Birkenhead graving docks. On the following day the meeting was continued, the first paper to be read being by Mr. R. H. Tweddell, and dealing with the application of water pressure to shop tools and mechanical engineering work. Mr. Winstanley followed with a paper on a compressed air coal-cutting machine; while, finally, came Mr. W. P. Baker with a contribution on machinery for decorticating grain. The afternoon of the second day was devoted to a visit to Laird Brothers' Birkenhead yard, and in the evening the anniversary dinner was held. During the remaining two days of the meeting, visits were paid to several collieries, cotton mills, and chemical works, and to the Crewe shops of the London and North-Western Railway Company.

Recent Developments in Boiler Engineering.

IN an article published in THE ENGINEER of March 4th, 1927, we described in full the process for the manufacture of water gas welded high-pressure boiler drums in use at the Thyssen Works of United Steel Works at Mülheim-Ruhr, Germany. In what follows the development of this process up to the present day is reviewed and a description is given of a new seamless rolling method for high-safety boiler drums.

MANUFACTURE OF BOILER DRUMS.

Boiler drums were originally made, almost without exception, by riveting plates together. Up to 15 atmospheres or 215 lb. per square inch such boilers had in general

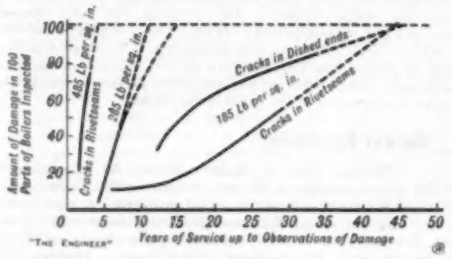

Amount of Damage in 100 Parts of Boilers Inspected
100
80
60
40
20
485 Lb per sq. in.
285 Lb per sq. in.
185 Lb per sq. in.
Cracks in Rivetseams
Cracks in Dished ends
Cracks in Rivetseams
0 5 10 15 20 25 30 35 40 45 50
"THE ENGINEER"
Years of Service up to Observations of Damage

FIG. 1—CURVES OF BOILER DEFECTS

a satisfactory life. It was soon found, however, that with further increases in pressure boiler defects began to assume hitherto unknown proportions. Fig. 1 shows graphically the interesting observations of Ullrich* on riveted boilers with working pressures of 13, 20 and 34 atmospheres, or 185 lb., 285 lb., and 485 lb. per square inch respectively. From the diagram it will be seen that up to 13 atmospheres appreciable defects only occurred in the boilers after they had been in operation for about fifteen years. With riveted boilers working at a pressure of 20 atmospheres, on the other hand, about 40 per cent. of all the boilers showed defects after only seven years, while with 34 atmospheres 60 per cent. of the boilers under observation showed defects after only two to three years.

Careful investigations as to the cause of such defects showed that they were mainly traceable to the effects of deformations of the material in the cold state, more particularly during riveting. It is now a matter of common knowledge that soft mild steel exhibits considerable stress within the deformed areas, to which must be added progressive embrittlement or ageing. It would appear that the pressure stresses in the boiler, acting on the strained parts which have become brittle, lead to the formation of cracks, which occur all the sooner if the boiler is highly stressed. These deformation effects occuring in the cold state can be removed by annealing, a measure which can, however, only be adopted with non-riveted drums, as any riveted joints would undoubtedly become loose during such heat treatment.

Water gas welding was the only method employed until quite recently, but within the last few years successful attempts have been made to introduce electric welding in the manufacture of boilers. To what extent, however, fusion welding may replace water gas welding only practical experience over a number of years can show. For the present the water gas method, which has proved so satisfactory for boiler manufacture, must take first place. For relatively low pressures it is usual to weld the longitudinal seam and rivet in dished ends. Whilst experience has shown that this type of drum is quite satisfactory for medium pressures, say, of about 15 to 25 atmospheres, or 215 lb. to 355 lb. per square inch, and few boiler defects have so far appeared, yet for higher pressures the riveted end seams form a source of danger, as rivet hole cracks may occur. By closing in the ends of the shells hemispherically by means of a special hydraulic press all riveting was entirely dispensed with. In this process the wall of the boiler end becomes thicker towards the edge of the manhole, a fact which is important from the constructional point of view, as by this means the strength at the highly stressed manhole edge is thereby considerably increased.

With modern rolling mills having rolls of 4·5 m., or 14ft. 9in., length, which will take plates of the largest size made, water gas welded drums up to 1350 m., or 4ft. 5in., external diameter can be made with a single longitudinal seam. Only for larger diameters does it become necessary to make the boiler drums out of two plates having two longitudinal seams.

The introduction of the closed drum has made it possible to eliminate all cold deformations and strains caused during manufacture by a subsequent heat treatment, and in addition it enables the finished drum to be subjected to a test which guarantees the reliability of the whole drum and more particularly the weld seam. The hemispherical shape of the closed-in end and the thickening of the wall at the manhole edge allow all finished drums to be subjected to a static or oscillating test pressure, during which the cylindrical part is stressed beyond the yield point without, however, any bulging of the ends occurring. By applying such severe stresses as could never occur in service without serious permanent deformation resulting, any faulty place either in the plates or the weld seam must show up. As, however, the material may become strained and local cold deformation may even occur during this test, the drum is annealed as a whole in order to get rid of these and also any strains and deformations caused during the earlier operations. More than 1000 drums made in this manner have so far been supplied, in the manufacture of which about 10,000 tons of plates have been used, yet none has failed or shown the slightest defect, although over 70 per cent. of them operate at a pressure of 35 atmospheres, or 500 lb. per square inch, and higher.

While relatively soft steels have hitherto had to be used for the manufacture of water gas welded boiler drums, it becomes necessary with high pressures to adopt greater wall thicknesses, which are undesirable in all cases where a saving in weight is a consideration. Hence attention has been given to the manufacture of seamless drums which can be made of harder steels and those of relatively higher alloy content. With a view to reducing the manufacturing costs of such seamless drums the United Steel Works have now substituted a continuous rolling process for the laborious and costly forging process. This process is based on the work of Herr M. Roeckner, who has invented a radial rolling mill shown in Fig. 2, in which hollow ingots can be rolled out to long drums of large diameter. The process is based on an operation long recognised in the forging art. This process is illustrated in Fig. 4. It will be seen that the material is extended by the use of profiled rolls—see A B C D, Fig. 4. If a plate, brought to red heat, is passed through such a system of rolls placed one behind the other in the direction of the arrow (Fig. 4) at a certain distance from the edge of the plate the plate would be drawn out by a certain amount towards the edge. The same effect can be obtained with a hollow ingot if the rolls be arranged in such a manner that the upper rolls, as indicated at F in Fig. 4, engage at the outer periphery and the lower rolls at the inner side of the hollow ingot. If the rolls be, moreover, slightly inclined, the hollow ingot will be drawn through the rolling mill with a screw-like action and be continuously extended.

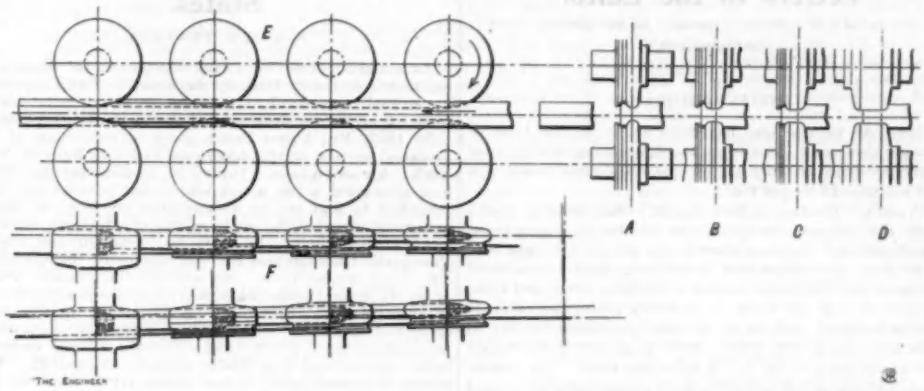


FIG. 4—DIAGRAM SHOWING SEQUENCE OF ROLLING OPERATIONS

FIG. 2—RADIAL ROLLING MILL FOR BOILER DRUMS

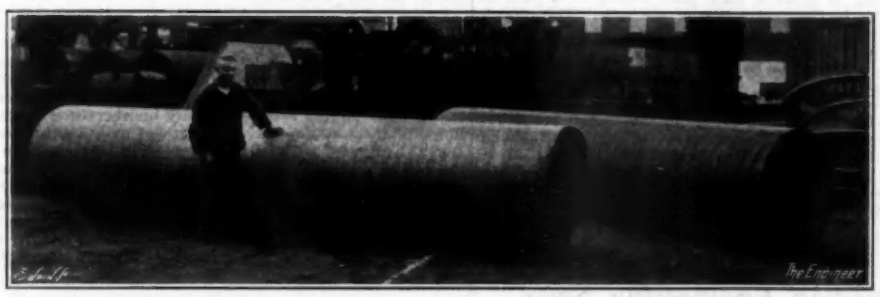


FIG. 3—BOILER SHELLS MADE BY THE SEAMLESS ROLLING PROCESS

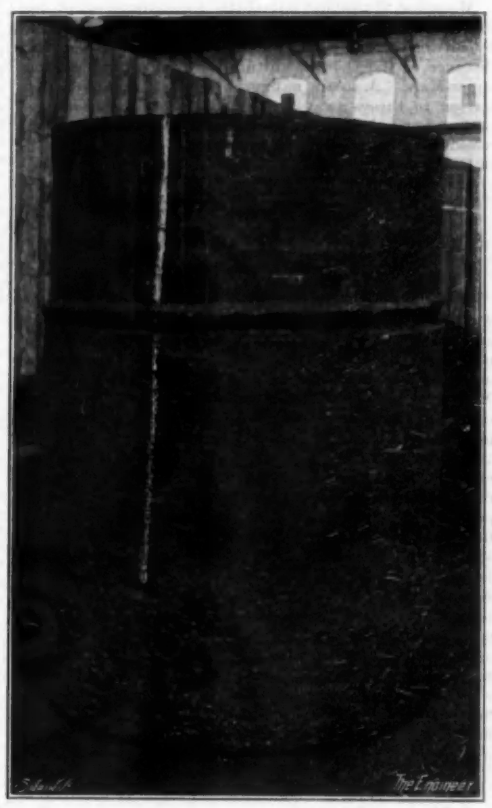


FIG. 5—INGOT SHOWING ROLL IMPRESSIONS

By means of this rolling process a hollow ingot can be quickly rolled out into a seamless drum. This radial rolling process ensures a thorough homogeneity of structure resulting from a very complete working of the material, as every part of the hollow ingot is forced to pass the narrowest calibre of the rolls. Fig. 5 shows an ingot on which the rolling operation was interrupted. The groove produced by the first roll will be seen, but the remainder towards the top has been drawn out by the second and third rolls. Fig. 3 shows a couple of shells of about 3ft. 3in. diameter and with a wall thickness of nearly 1⅛in., produced by this method. These drums after being closed are

* "Werkstoffragen des heutigen Dampfkesselbaues," page 110. Julius Springer, 1930.

subjected to the excess pressure test and annealed in the same way as welded drums.

We are indebted for assistance in the preparation of this article to Dr.-Ing. F. Nehl, of the firm's experimental department, and to Mr. Hamilton Martin, M.I.N.A., A.M.I. Mech. E., who represents the British interests of the United Steel Works for these specialised manufactures, at the offices of the Steel Union Trading Company (Great Britain), Ltd., Finsbury-court, Finsbury Pavement, E.C. 2.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

ROAD AND RAIL.

SIR,—As no one else has done so up to the time of writing this, may I challenge the figure suggested in your correspondence of July 1st for the rolling resistance of a rail wagon—15 lb. per ton ?

Wood's "Treatise on Rail-Roads," 1831, deals at length with the subject, recording the results of experiments which showed the resistance to be about 9 lb. per ton.

To-day, with improved lubrication, better machined surfaces, and the much harder steel axles, tires, and rails, instead of iron, the figure is probably about half what it was a hundred years ago. A table published by Fry in THE ENGINEER, Vol. CVII., 1909, page 335, gives wagon resistance as 4·57 lb. at 10 miles per hour. An empty wagon weighing 5 tons 7 cwt., with grease lubrication, and after standing for some days, can be started from rest by one man.

But the figure given by your correspondent for the rolling resistance of a modern road lorry, 30 lb. per ton, is little better than that given by Macneil in 1832 to the Select Committee on Steam Carriages on Roads—33 lb. per ton on a "well-made pavement"—the nearest approach then available to a modern first-class road.

As regards the suggestion that a switchback track involves no working losses, I would refer to Robert Stephenson's report on Badnall's "Undulating Railway" theory, which threatened, with other fallacies, to become fashionable at the time in railway circles. Though some of his objections relate particularly to steam locomotives, others are valid of any machinery. The report is given in the *Mechanics' Magazine*, 1835, Vol. XXII., page 390.

Moreover, if gradient be so little damaging in effect, one may ask why it has been considered necessary to reduce it by cutting a costly serpentine by-pass road (within a short distance of the G.W.R. cutting at Uphill) near Weston-super-Mare. A steam navvy is at work, with a fleet of lorries, to throw away at the same time the excavated material and the tax and ratepayers' money. Their only consolation would appear to be that the late Ministry of Transport was sounder on mechanics than economics.

Bath, July 27th. J. G. H. WARREN.

TEMPERATURE AND THE RESISTANCE OF FLUIDS.

SIR,—In your issue of July 1st you published a letter written by Mr. J. H. Lamble regarding the temperature and the resistance of fluids and commenting on my statement that the results obtained by Schoenherr and those which he had given in his paper before the Institution of Naval Architects in March last did not agree. I would invite Mr. Lamble to consider the statement of Schoenherr's that "it is seen from Fig. 2 that the spots from all the tests define very closely a mean line," *i.e.*, all his experiments lie on one line, no matter what the speed or temperature may be. If one turns to Fig. 3 of Mr. Lamble's paper it will be found that the results which he obtained lie on altogether seven different curves, one curve for each speed which he tried. In other words, Lamble's results lie on individual curves according to the individual velocity, whereas Schoenherr's all lie on one curve. In this respect, therefore, I think that my comment that the results produced by these two experimenters did not agree is justified. I might add that at close reading Schoenherr's paper shows that in all probability he was working with water which was in completely turbulent flow, owing to the roughening which he had made at the fore end of his plank, whereas Lamble was probably working in partially turbulent and partially laminal flow.

G. S. BAKER, Superintendent,
The William Froude Laboratory.

Teddington, July 21st.

"COLLOIDAL FUEL."

SIR,—Mr. Wright's figures on the cost of preparing coal-oil mixtures given in your issue of the 22nd instant are hardly fair to the material. A better comparison would be with straight fuel oil rather than unground coal, in which case the figures are much more favourable. However, for freighters where weight counts there is not much in it, the advantages lying rather with the larger passenger vessels which aim for the maximum therms in the minimum space.

As a fuel for Diesel engines work on this subject is now being initiated on the Pawlikowski system, and it is hoped that by suitable modifications to the existing test plant it will be possible to dispense with the auxiliary powdered coal injection attachment and fire direct just as in normal Diesel practice. Whether the application is likely to benefit the coal industry will not be apparent for some time, but sufficient work has already been done on colloidal fuel in several directions to justify the assumption that for all practical purposes it will never be absolutely essential to grind coal to a degree of fineness that is truly colloidal, and fears that excessive grinding costs will be prohibitive to its utilisation can be largely discounted.

London, S.W. 1, July 25th. JOHN L. STREVENS.

Pneumatic Railways in the United States.

By E. E. R. TRATMAN.

As a matter of record, or an addition to the history of pneumatic railways, recently discussed in THE ENGINEER by several correspondents, it may be of interest to note some experimental work carried out in the United States.

In 1867, Mr. Alfred Beach gave an exhibition of his proposed system at the American Institute Fair, in New York. A wooden tube or tunnel 6ft. in diameter and 107ft. long contained a car which seated ten persons and was propelled to and fro by atmospheric pressure, air being exhausted ahead of the car by means of a 10ft. fan running at 200 revolutions. In 1868 he organised the Beach Pneumatic Underground Railway Company, for operating city rapid transit lines. He actually built nearly 300ft. of an 8ft. tunnel under Broadway, near the intersection of Warren-street. This line was operated in the way described, and trips for demonstration purposes were made occasionally until about 1882. But the scheme received little support and was finally abandoned in 1883. The tunnel remained until it was destroyed in building the first electric underground railway about 1908, as the beginning of the city's present comprehensive system of underground rapid transit lines. It is of particular interest to note, however, that Mr. Beach drove his tunnel by means of a shield which he had invented, and which was the first tunnelling shield used in the United States.

In 1908, Mr. Joseph Stoetzel started to promote a pneumatic railway scheme at Chicago, and for demonstration purposes built an experimental line with a concrete tunnel or conduit—above ground—having a length of 2200ft. To make a little money out of the venture it was situated in a pleasure park or resort and was operated as an attraction as well as for experimental work. This project lasted only one summer, however, and soon afterwards the park was abandoned and the tunnel was destroyed when the ground was cleared for other purposes. In plan this tunnel line was in the form of a loop, with several curves and with a maximum gradient of 1 in 10. In section it was 5ft. wide and 6ft. high, with vertical sides, a flat floor and an arched roof. The cars were of light steel skeleton framing, covered with wire netting as a protection. They were 12ft. long, on double bogies, with the floor dropped between the bogies. Each car weighed about 1300 lb. and could seat twenty passengers. At each end was a bulkhead or diaphragm fitting fairly closely to the section of the tunnel. The cars were run separately, but with as many as four cars in the tube at one time, the air confined between them serving as a cushion or buffer to keep them apart. With a motor-driven fan creating a vacuum of 2in. or 3in. a car would make the trip of 2200ft. in about 75 seconds.

Both the above experiments represented the tunnel type of pneumatic railway. The pipe system has also been the subject of experiment. In it, the vacuum is created in a pipe laid between the rails and containing a piston which is connected to the car above by a bar or plough extending through a slot along the top of the pipe. This is the system developed in England by Medhurst, Pinous, Clegg, and Samuda from 1812 to 1840, and also actually applied on an extensive scale by Brunel about 1844. In France it was developed by Hallette in 1847. In more modern times Mr. C. H. Goebel built at Philadelphia, U.S.A., in 1890, a line of rails about 80ft. long, with a car seating fifteen passengers. Between the rails was a 6in. pipe. Instead of following earlier practice in closing the continuous slot—before and behind the plough—by elastic materials and sealing devices, he used a series of sliding plates 6in. long and working in grooves, each plate sliding in a path at right angles to the centre line of the pipe. The plough engaged studs or buttons on each plate in such a way as to move each plate back in front of the plough and return it to its former position behind the plough. Nothing came of this experiment.

The closed pipe system of pneumatic transportation has been developed to a high degree in the United States for the transmission of messages and mails. At one time, and until a few years ago, mail bags were handled in this way between the main post office at Chicago and some of the railway terminals. This system, however, is distinct from the pneumatic railway system.

Canadian Engineering News.

Refractories Industry.

A NEW Canadian company, the Walker-Hinds-Sutherland Refractories, Ltd., is making an extensive search of the Montreal district for clays suitable for the manufacture in Montreal of refractory cements and fire-bricks for use in the Canadian iron and steel industry, as well as in all industries employing high temperatures. At present practically all refractories used in Canadian industry are imported from the United States.

Rural Electrification.

During the past few years very substantial progress has been made in the province of Ontario in the field of rural electrification. Practically all rural electric service is now given through rural power districts which are operated directly by the Ontario Hydro-Electric Power Commission. Toward this rural work the Ontario Government, pursuant to its policy of promoting the basic industry of agriculture, has, in the form of grants-in-aid, contributed 50 per cent. of the costs of transmission lines and equipment, or some 7,677,000 dollars. In all, 8197 miles of transmission lines have been constructed to date. There are now more than 55,000 customers supplied in the rural power districts. The mileage of line and capital expenditure have increased at a much greater rate than the number of consumers. This fact is regarded as evidence that the rural service is reaching out to serve residents in less densely settled parts of the province.

Important Oil Find in Turner Valley.

Hylo No. 1 well, in the southern section of Turner Valley, Alberta, has developed into a huge wet gasser, with a production expected to reach 300 barrels of naphtha daily. The well has been yielding crude oil at a rate of nearly 100 barrels daily since production was obtained in the Home sands in October last, and the further drilling of the well into the limestone has been financed from the crude output. In carrying the well deeper, excellent gas showings were obtained at a depth of 5670ft., of which 170ft. were in the limestone. First production tests showed a yield at the rate of 200 barrels of naphtha daily, and when the proper pressure is determined, the output is expected to be greatly increased.

Railway Economies.

Recent revenue figures reflect an appreciation by the managements of the two major railway systems of the need for rigid economies in administration and operation. The Canadian National Railway statement for the first five months of the calendar year shows evidence of drastic and far-reaching curtailment. During this period the gross revenues of the system were 57,750,742 dollars, a reduction of 15,288,654 dollars, as compared with the corresponding period of 1931. Against this falling off, however, there was a saving in costs of operation amounting to 15,035,431 dollars, and the operating ratio was down from 98·4 per cent. to 97·95 per cent., the system showing a net revenue of 1,180,818 dollars. The Canadian Pacific Railway has been steadily pursuing a policy of reasonable retrenchment, with remarkable success. Reduced expenses during the month of May set a saving of 2,451,589 dollars against a decline of 2,788,473 dollars in the gross earnings, leaving a relatively unimportant decrease in the net revenue for the month, while, for the five-month period, a drop of 12,039,503 dollars in the gross operating income was offset to an amount of 10,826,230 dollars by means of working economies.

Synthetic Resins.

During recent months the National Research Council of Canada has been carrying out research work on a new colourless, glass-clear synthetic resin, which seems to have commercial possibilities. It is prepared by the polymerisation of an unsaturated ester. The work has naturally divided itself into three phases:—(1) A study of methods of preparing the ester, with the object of discovering the best and most economical method; (2) a study of methods of polymerising the ester; (3) the properties of the products. Promising results have been obtained in the use of the resin for the manufacture of non-shatterable glass. In an accelerated light exposure test, sandwich glass made with the resin showed no discoloration, while glass made in the usual way with celluloid turned brownish. The resin would also appear to be a suitable constituent of lacquers. In addition, some study has been given to two resinous condensation products.

British Coal.

For the first time in history, imports during May this year of anthracite coal from Great Britain exceeded those from the United States. Imports of British anthracite during that month amounted to 170,967 tons and from the United States 150,802 tons. In May, 1931, imports of British anthracite amounted to 142,911 tons, and from the United States 209,894 tons. Indications are that the trend to buy more British than United States coal will be continued during the season of navigation on the St. Lawrence River.

Largest Vessels Use Canal.

The new Welland Ship Canal, which links Lakes Erie and Ontario by overcoming the drop of 326ft. in the 27-mile stretch between the two, is now able to accommodate the largest vessels that ply on the Great Lakes. Some of these vessels have a length of over 550ft.; one, the "Lemoyne," is 621ft. long. The "Gleneagles" has a length of 582ft. and a breadth of 60ft., with a gross register tonnage of 8233. The complete use of the new waterway is being brought about progressively. Although the locks are capable of accommodating vessels up to 820ft. in length, certain dredging remains to be done to permit some of the longer craft to navigate curves with perfect safety.

Vancouver's New Traffic Bridge.

Burrard Bridge, spanning False Creek inlet and connecting the business section of Vancouver with the residential area on Dominion Day, July 1st. The new bridge was built at a cost of approximately 3,000,000 dollars. The structure is an engineering and architectural achievement of the first magnitude. The central span is 315ft. long and allows a clearance for navigation of 90ft. at high tide. It is supported by two massive ornamental piers, each 200ft. high and 41½ft. by 200ft. at the base. The roadway of the bridge is 60ft. wide, providing for six traffic lanes, three in each direction, and 9ft. side-walks are provided on each side. The plans provide for the addition of a lower deck to carry railway and street car tracks.

A FIRM manufacturing motor tire valves with factories in Switzerland is starting work in Birmingham and, it is said, will employ about 300 workpeople.

Railway and Road Matters.

WORK has been restarted on the new railway line between Darnall and Tugela, on the North Coast of Natal, which is 10 miles long. The estimated cost is £136,000.

DURING the four weeks ended May 21st the London, Midland and Scottish had 90 per cent. of its 14,423 express trains arrive at their destination on time, or not more than five minutes late. For 238,610 local trains the proportion was 95 per cent.

THE annual report for 1931 on the railway accidents and casualties of that year, prepared by Lieut.-Colonel Mount, the Chief Inspecting Officer of Railways, has now been issued as White Paper, Cmd. 4132, price 1s. Its main features are referred to elsewhere in this issue.

THE Irish railway companies have sent formal letters to the three railwaymen's unions asking for a joint meeting to discuss a reduction in wages owing to the serious financial position of the railways. The present rates were agreed to on May 9th, 1931, and three months' notice is necessary to terminate that agreement.

WHAT are officially known as the Railway Returns contain a summary of the information furnished in the railway companies' annual reports, together with further details found in the Ministry of Transport railway statistics. The former cover the capital, traffic receipts, expenditure, and the plant of the railways. The Returns for 1931 have just been issued as a Stationery Office publication, price, post free, 6s. 10d.

IT is hardly correct to say that the "Flying Scotsman" has run for seventy years without an accident. Whilst it is true that no passengers have been killed in an accident to that particular train, three servants lost their lives in the derailment of August 10th, 1880, on the North British side of Berwick. The up line was being re-sleepered and only one spike was temporarily in each chair. A green flag was put up 500 yards from the work, but there was no flagman and no detonators. The Board of Trade Inspector recommended that the rules thereon should be improved.

THE Armstrong-Whitworth Diesel-electric motor coach "Lady Hamilton," which carried out a number of demonstration runs from King's Cross recently, put up a very creditable performance on its return journey to Newcastle. The actual running time for the trip was 5 h. 38 min. Having regard to the fact that the maximum speed of the coach is limited to 65 m.p.h., and to the number of checks and signal stops made to allow the regular traffic to pass, this time compares very favourably with the 5 h. booked time of the non-stop "Flying Scotsman." The fuel cost at this high speed was, we are informed, about ¼d. per mile.

IN connection with the conversion from two lines to four of the Great Western line between Stapleton-road, Bristol, and Filton Junction, an arch bridge of 68ft. span was recently demolished. The work was done by fifty-four charges of gelignite, which, after the earth and clay and the spandril walls had been cleared away down to the extrados of the arch, were arranged in seven rows of holes drilled to an average depth of 27in. The charges were placed not less than 2ft. from the edge of the arch and not more than 2ft. apart. They were fired by means of two submarine electric detonators, one being connected to thirty-seven of the charges and the other to seventeen. According to the *Great Western Railway Magazine*, the explosions were simultaneous; the arch dropped clean at springing level and the *débris* was well broken up.

WE would like to extend the reference to Mr. W. Bridges Adams, which appeared in our "Sixty Years Ago" note on July 22nd, and the mention therein of his invention of the fish-plate for joining the adjacent ends of rails to each other. That invention was the subject of patent No. 11,715 of May 24th, 1847, which recited that the invention consists in, firstly, improved modes of securing the joints of the rails to render them more firm and durable and prevent the dangerous tipping of the joint sleepers. For that purpose two sleepers were used, one on each side of the joint, instead of one sleeper directly under the joint, and a chair is placed on each sleeper beneath each of the two rails. To connect the two rails together wood or metal fishes were used in such mode that the fishes would support the rails vertically. The two rails might abut square together or be scarfed. It is only fair to add that Mr. E. E. R. Tratman, in his "Railway Track and Trackwork," says that "The flat splice bar or fish-plate was invented in this country (the United States) in 1830 by R. L. Stevens for the Camden and Amboy Railway, and it was re-invented in England in 1847 by Mr. W. Bridges Adams."

AN object lesson of the evils of the State management of railways is furnished by the resignation of Sir Henry Thornton, the president and chairman of the Canadian National Railways. In sending in his resignation Sir Henry said that, in his opinion, a State-owned railway could only be successfully directed if the management had the complete confidence of the owners of the property. The public criticism to which he had been subjected indicated that such confidence was not general, and in view of the financial depression and the fact that a Royal Commission was investigating the whole railway situation of Canada he felt he should tender his resignation. It may be remembered that, on the invitation of Lord Claud Hamilton, the chairman, Sir Henry Thornton was, in February, 1914, brought to this country from the position of general superintendent on the Long Island Railway to be the general manager of our Great Eastern Railway. He was credited with having many schemes in view for the improvement of that railway—one was to restore the junction with the Metropolitan at Liverpool-street, and another was to join the suburban lines with the Central London—but the war prevented any development of such plans. Instead, Sir Henry became Inspector-General of Transportation, in which post his energies found full employment with excellent results. Rumour was very busy with his future when the Great Eastern was to be absorbed under the Railway Act, but a solution was found in his appointment in 1922 as president of the Canadian National Railways, which he has raised into a valuable property.

Notes and Memoranda.

THE new bridge across the Nerbudda, India, which connects Nagpur with Jubbulpore, has eight spans of 50ft., six spans of 105ft., and approaches of 125ft. and 45ft. The river is subject to floods of 80ft rise, half of which will be allowed to flow over the top of the bridge.

A GIANT medium-pressure pneumatic tire is being manufactured by the Goodyear Tyre and Rubber Company (Great Britain), Ltd. It has a sectional diameter of 16·38in., and an overall diameter of more than 4ft. Its assembled weight is 563 lb., and it is stated that it can easily support a load of 10,500 lb.

THE Ganges Canal hydro-electric scheme now provides some sixty-six towns and large villages from about 900 miles of high-tension transmission line. The four water power stations can generate 7600 horse-power and are supplemented by oil engines of 2400 horse-power. The cost of the scheme has been Rs. 1,24,00,000.

ACCORDING to the report of the Industrial Health Research Board, "most people free from nervous symptoms can become indifferent to a noise relevant to their work or regularly continuous; a large number of nervous people cannot become so adjusted. A study of the phraseology used by people susceptible to noise suggests that one factor in the mental effect is resentment, the noise being regarded as an assault upon their right to quietness."

TWO more international bridges are in prospect over the Rio Grande, one in the lower valley at Boca Chica, by the Boca Chica Bridge Company, and the other in the upper valley at Fort Hancock, by the Fort Hancock-Porvenir Bridge Company. Each structure will cost about 250,000 dollars. The Mexican Government has granted permits for the two bridges and Bills are pending in Congress for similar authority. Both measures have passed the House. Everything is in readiness for beginning construction of the bridges as soon as congressional approval is given.

A PROCESS for oil refining has been worked out by the Naphtha Research Institute of Moscow, and is described briefly in the *Chemical Trade Journal*. In this process the petroleum vapours from the distillation plant are led, before entering the condenser, into a column filled with zinc chloride, in which the olefines, &c., polymerise and separate out. These latter products should, it is believed, find application both in the varnish industries and as a fuel. The zinc chloride is washed out from the polymerisation products by water, and regenerated for re-use by evaporation.

NOISE, vibration, and dust are inseparable from many industrial processes, but whereas dust is an objective reality, noise and vibration have subjective effects which are difficult to assess. It is these and analogous subjective abstractions which are among the most complex of our modern industrial problems, and the psychological questions raised are as important as the physiological aspects. Employers and employed must be well informed on such matters, since a wise evolution of economic policy is otherwise impossible, and the Industrial Health Research Board, whose twelfth annual report has just been issued, endeavours to teach them.

A NEW field for palm oil may be provided by its utilisation as a fuel for Diesel and semi-Diesel engines. Experiments have been attended with some success, but no commercial development has ensued where other fuels are available at low cost. In the Belgian Congo, where petrol is relatively dear, palm oil has been successfully substituted for utilisation in special motors, and much satisfaction has been evinced at the results obtained in the case of heavy transport vehicles. Not only has the cost of transport been thereby substantially reduced, but the inconvenience attaching to the use of highly volatile fuels in countries of high temperature has been obviated. As yet, this form of utilisation is still largely in an experimental stage, and has no great commercial importance. Its potentialities should, nevertheless, not be overlooked, and it may possibly provide in the near future an important outlet for palm oil consumption.

A NEW model home television receiver was recently exhibited in the Baird laboratories in Long-acre. The image is thrown upon a screen 4in. wide by 9in. high, which can be seen at a considerable distance, and this obviates the necessity for looking into a lens, which was essential with the former apparatus. Moreover, the image can be viewed without putting the room in total darkness. The new machine measures, when closed, 1ft. 6in. in length by 8in. wide and 13in. high. The apparatus is worked from the mains, and it can be operated with any first-class wireless set. It differs from the former Baird model in that a mirror drum replaces the disc, and the neon lamp is replaced by a special form of Kerr cell. One of the great difficulties in utilising the Kerr cell has been that very high voltages were required, such voltages making it impossible to turn out a model suitable for home use. By using a special patented construction, however, this difficulty has now been overcome. The Kerr cell modulates the light from a small filament lamp. The images produced are brilliant and clear, and the red colour of the neon tube has been eliminated.

ACCORDING to a Department of Overseas Trade report on the radio apparatus market in South Africa, the number of effective licences at February 29th last was 41,727, there being a considerable increase during the last twelve months, and it has been estimated that there are possibly some 12 to 15 per cent. of the sets still unlicensed. This number represents a comparatively small proportion of the total European population who could be served from the broadcasting stations, and there is little doubt that the potential market is by no means exhausted. At present, however, South Africa is not very "radio minded," although the listening-in habit is growing rapidly. It is not possible to-day to attempt to estimate the future potentialities of the native and coloured population. The type of receiving set in demand is one of high selectivity with equally high sensitivity, and provided with a moving coil loud speaker. With regard to selectivity, receivers should have three or more high-frequency stages. The all-electric set has a predominant share of the market, and there is a greater demand for the smaller sets than for the very expensive ones.

Miscellanea.

THE Rangoon water supply scheme has been abandoned.

DEVONPORT DOCKYARD will be closed from July 30th to August 8th for the annual holiday.

THE Guernsey States have refused to renew the concession to the Guernsey Electric Light Company, as a preliminary step towards the municipalisation of the service.

THE passenger liner "Euripides" is to be converted from coal to oil burning before her next trip to New Zealand. Her accommodation and decorations are also to be remodelled.

THE electors to the Lucasian Professorship of Mathematics at Cambridge have elected Dr. Paul Adrien Maurice Dirac, Ph.D., F.R.S., Fellow of St. John's College, to succeed Sir Joseph Larmor, who will vacate the professorship on September 30th.

THE present plant of Palestine Potash, Ltd., at the Dead Sea is capable of producing a ton of refined bromine a day. A second plant of double this capacity is being erected. During last year 13,000 tons of crude potash salt were harvested by the company.

IT is estimated that work will be provided for 200 Englishmen by the arrangement of a Continental firm for the manufacture in Hull of such commodities as wooden switch blocks, tool handles, &c. The necessary wood will, obviously, be imported.

THE contract for the four 30ft. steel penstocks for the Hoover Dam hydro-electric plant in America, which has been secured by Babcock and Wilcox, of Ohio, involves 50,000 tons of steel work, ranging in thickness from 1⅛in. to 2½in. The work is to be completed in about five years.

THE output of the wire works of the Union Steel Corporation of South Africa, from 4127 tons in 1930 to 6164 tons in 1931, and the value of the products increased from £53,459 in 1930 to £73,260 in 1931, and whatever is possible to increase the activity of this section of the works is being done.

THE storage of coal gas for town's service under high pressure instead of in large gas holders is becoming the vogue in Germany. Pressures of about five atmospheres are being used, with a corresponding reduction in the bulk of the holder. The scheme naturally involves the use of a compressor, which is generally of the rotary type.

THE Dominion Bureau of Statistics at Ottawa has issued its finally revised statistics on the output in 1931 of metals of the platinum group, indicating that 91,693 fine ounces of platinum, palladium, rhodium, iridium, and ruthenium valued at 2,814,617 dollars, were produced from Canadian ores in 1931, as compared with 68,116 fine ounces worth 2,439,128 dollars in 1930.

A SEWAGE sludge steamer of the Manchester Corporation, the "Joseph Thompson," is about to be put out of commission in favour of a new vessel. She was built by the Naval Construction and Armaments Company, Ltd., of Barrow-in-Furness, in 1897, and cost about £25,000. It is said that she has covered a distance of 780,000 miles and dealt with 6,700,000 tons of sewage cargo during her life. Her successor is to be built by Ferguson Bros., of Port-Glasgow, and will be of about the same capacity, but will cost £49,000.

AN unusual type of tug boat has been put in service on the Rio Magdalena, Colombia, between Barranquilla and La Dorado, where the stream is very rapid. She is driven by engines of 200 horse-power and gets up the rapids by winding in a wire rope about a mile and a-half long, $1^{37}/_{64}$in. in diameter, laid on the bottom of the river. The rope is coiled up on board as it is wound in, and can give a tractive effort of 20 tons. The speed upstream is at the rate of about 100ft. per minute. The tug is also equipped with quadruple propellers, which can be used for manœuvring.

A FACTORY in full production has just been moved by the Great Western Railway from London to Chippenham—94 miles—without interruption with its business. The removal included 750 tons of machinery, the household effects of thirty-six families and over 100 persons. Every bit of the traffic was conveyed in containers and the removal so arranged that machinery at work one night was dismantled, loaded in containers, conveyed by road to Paddington for dispatch by rail to Chippenham and re-erection in the new factory in time for immediate use next morning. No piece of machinery was out of use for longer than fourteen hours.

THE "Lloyds," the latest boat of the Royal National Lifeboat Institution, which has just been launched at Cowes, is a cabin motor lifeboat of the largest and most powerful type now being built by the Institution—the Barnett (Stromness) type, 51ft. by 13ft. 6in. She is divided into eight water-tight compartments, and is fitted with 160 air cases. She has twin screws and is driven by two 60 H.P. engines. Her speed is just under 9 knots. She carries enough petrol to be able to travel 120 miles at full speed without refuelling. She has seating accommodation in her cabin for ten people, and in rough weather can take 100 people on board. She carries a crew of eight men. She has a line-throwing gun and an electric searchlight, is lighted throughout with electricity, and is fitted with an oil spray in the bows for spraying oil on the waves to make smooth the water round the wreck.

THE International Telephone and Telegraph Corporation announces that an agreement has been concluded between the Minister of Communications of China and the Mackay Radio and Telegraph Company for the exchange of radio telegraph traffic between China and the United States, Hawaii, and the Philippines. A further agreement has been concluded between the Ministry of Communications of China and the China Electric Company, a subsidiary of the International Telephone and Telegraph Corporation, for the erection of four radio telephone transmitting and receiving stations for communication within China, one to be at Shanghai and the other three at other important cities in that country. In addition to these an international radio telephone station will be built at Shanghai so that the rest of the world can be connected to more than 100,000 telephones now in China.

BY-PRODUCT PLANT AT THE NORMANBY PARK STEEL WORKS, SCUNTHORPE

THE WOODALL-DUCKHAM VERTICAL RETORT AND OVEN CONSTRUCTION COMPANY, LTD., WESTMINSTER, ENGINEERS

(*For description see page* 103).

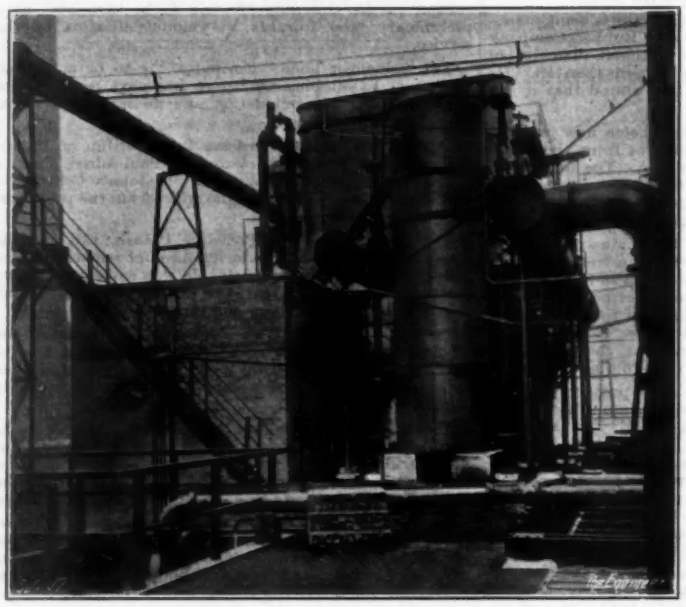


FIG. 13—LODGE-COTTRELL TAR PRECIPITATORS

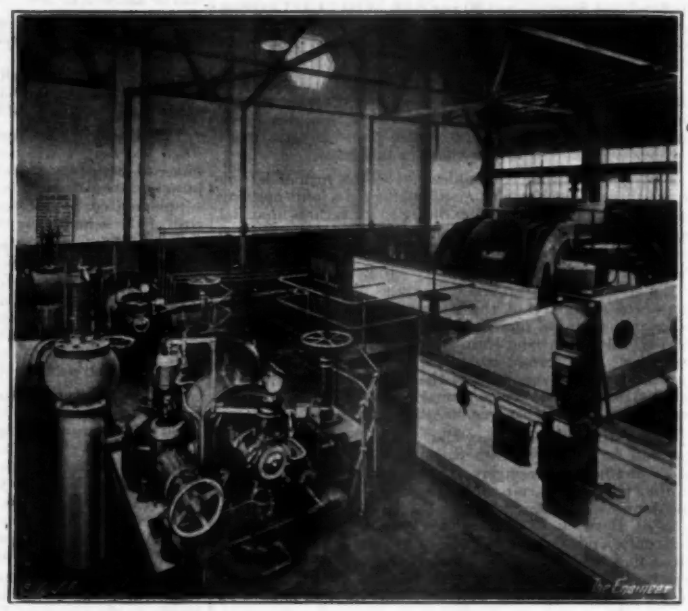


FIG. 14—EXHAUSTERS AND CENTRIFUGES

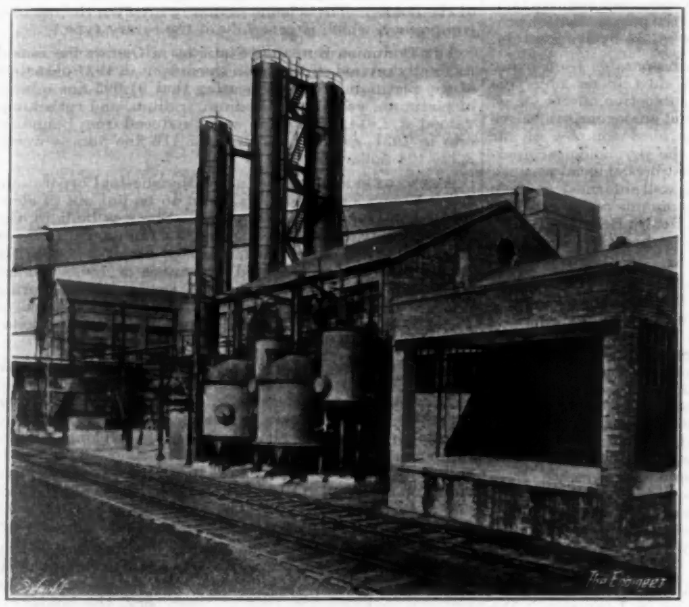


FIG. 15—AMMONIA SATURATORS AND SEPARATORS

FIG. 16—WILTON DRYER AND NEUTRALISER

FIG. 17—PUMP ROOM FROM GALLERY

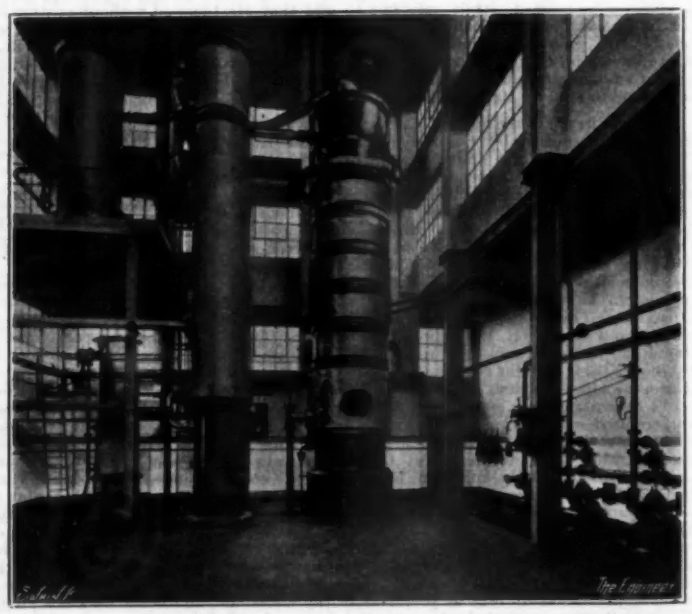


FIG. 18—WASH OIL STILL, ETC., IN BENZOL HOUSE

The Engineer

JULY 29, 1932.

VOL. CLIV. No. 3994

Contents.

THE ENGINEER, July 29th, 1932. PAGE

A SEVEN-DAY JOURNAL .. 101
THE ECONOMICS OF URBAN ELECTRIC RAILWAYS. No. II. (Ill.) 102
BECKER COKE OVEN AND BY-PRODUCT PLANT AT SCUNTHORPE. No. II. (Illus.) 103
CALCULATION OF STRESSES IN ARCHES WITH FIXED ENDS. (Illus.) 104
THE POSITION OF THE FOREIGN ENGINEER IN U.S.S.R. 106
AIR TRANSPORTATION OF GOLD DREDGES IN NEW GUINEA. (Illus.) 107
HYDROSTATIC PRESSURE WITHIN AND UNDER DAMS 108
SIXTY YEARS AGO 108
RECENT DEVELOPMENTS IN BOILER ENGINEERING. (Illus.) 109
LETTERS TO THE EDITOR—Road and Rail—Temperature and the Resistance of Fluids—"Colloidal Fuel" 110
PNEUMATIC RAILWAYS IN THE UNITED STATES 110
CANADIAN ENGINEERING NEWS 110
RAILWAY AND ROAD MATTERS 111
NOTES AND MEMORANDA 111
MISCELLANEA 111
LEADING ARTICLES—
The Composition of Mathematical Writings 113
Steam Engine Trials—Ancient and Modern 113
RAILWAY ACCIDENTS 114
OBITUARY—Dr. G. K. Burgess 114
THE METALLURGIST 114
THE "WHITE" COMBINED MARINE RECIPROCATING ENGINE AND EXHAUST TURBINE. (Illus.) 115
A NEW INDUSTRIAL PETROL ENGINE 116
A LARGE ELECTRIC WINDER. (Illus.) 117
TWO NEW LATHES. (Illus.) 117
A HIGH-SPEED PUMP. (Illus.) 117
ANTI-BREAKAGE COAL BUNKERING PLANT. (Illus.) 118
NEWS BY TELEVISION. (Illus.) 118
A QUICK REPAIR LINK FOR STOKERS. (Illus.) 118
REFRIGERANT FOR PERISHABLE TRAFFIC 118
IRON AND STEEL INSTITUTE AND INSTITUTE OF METALS 119
INDUSTRIAL DEVELOPMENT EXHIBITION 119
BRITISH STANDARDS INSTITUTION 119
AN AMERICAN STEAM POWER STATION 119
PROVINCIAL LETTERS 119
CONTRACTS 121
CURRENT PRICES FOR METALS AND FUELS 122
FRENCH ENGINEERING NOTES 123
BRITISH PATENT SPECIFICATIONS. (Illus.) 123
FORTHCOMING ENGAGEMENTS 124
PERSONAL AND BUSINESS ANNOUNCEMENTS 124
LAUNCHES AND TRIAL TRIPS 124

SIXTEEN-PAGE SUPPLEMENT—"THE METALLURGIST."

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The Metallurgist.

THE JULY NUMBER OF THE MONTHLY METALLURGICAL SUPPLEMENT TO "THE ENGINEER" ACCOMPANIES THIS ISSUE.

THE COMPOSITION OF MATHEMATICAL WRITINGS.

MATHEMATICS is a true universal language in so far that any statement couched purely in its terms can be understood with equal facility and accuracy by the natives of all countries. Nevertheless, it is peculiar as languages go, because while it can be read it can scarcely be spoken, and because it can be written very much more easily than it can be printed. Which of these two peculiarities is of the greater fundamental significance, it is difficult to say. It cannot be doubted that could mathematical formulæ be expressed by vocal sounds as cursively as a sequence of ordinary printed or written words may be recited, the teaching and the comprehension of mathematics would be greatly facilitated. Poetry in one sense is condensed prose, but words are frequently too clumsy a means of expressing the concentrated thought embedded in a mathematical formula. The difficulty presented by the vocalisation of mathematics is probably the root of the troubles commonly encountered by many who seek to study the science, although they may not recognise it as the source of their failure to make satisfactory progress. Equally unrecognised, even by the majority of mathematicians themselves, is the difficulty involved in transcribing formulæ and expressions from writing into print. Few people outside the ranks of printers, editors, and the secretaries of scientific societies are fully aware of the trouble and cost of mathematical composition. Mathematics was a well-developed science long before the art of printing was invented. Many of its forms and expressions have been handed down to us from pre-typographical days, and concerning the bulk of the symbolism introduced subsequently, even in modern times, it can be said that little of it has been chosen with a view to facilitating the printer's work. Leibnitz's notation for differential coefficients, for example, is thoroughly bad from the typographical point of view, although its merits from the mathematical standpoint are undoubted. Anyone who has been brought into close contact with the intricacies of mathematical composition cannot fail to have recognised that reform is needed, not only in order to make such composition less troublesome and costly, but in order to promote accuracy and freedom from ambiguity. The subject is not of narrow interest. It affects not only the writers of mathematical articles, papers, and treatises, but all those who, even incidentally, have to read and study mathematical works.

It is then with more than passing pleasure that we welcome a pamphlet, "Notes on the Preparation of Mathematical Papers," which the London Mathematical Society has recently published. This pamphlet has been prepared by the secretaries at the request of the Council for the benefit of authors submitting papers to the Society. It is, however, available to the secretaries of other scientific societies and to the authors of any dissertations containing mathematical formulæ, and should have a very wide field of usefulness.* It is perhaps too much to hope that any important change can now be made in many of the symbols and forms of expression which give chief trouble in the composing-room or that it will ever be possible to introduce and adopt any serious measure of international standardisation in the writing and typographing of mathematics. Nevertheless, within the limits of existing mathematical style—and there is as much style in mathematical writing as in ordinary prose writing—there are alternatives available, the discriminatory use of which can go a long way towards securing the principal benefits that would attend reform and standardisation. To those not acquainted with the art of type setting, it may be difficult to realise how much work and time may be saved by some apparently trifling modification of style in a mathematical expression. As a very simple example, consider any expression of the form $\sqrt{a\,x^2+2\,b\,x+c}$. The "rule" by which the root sign is extended to cover the whole expression is the impression of a separate piece of sharp-edged brass, which has to be cut by hand to the correct length and dropped into position in contact with the top end of the $\surd$ sign. In order to compensate, or "justify," the rest of the line for the insertion of this rule, a piece of brass of the same thickness, but less than type high, has to be placed on each side of it. Three pieces of brass have therefore to be cut by hand to exact lengths in order to permit this expression to be printed. Further, the insertion of these pieces naturally upsets the spacing between the line of print in which the expression occurs. Either of the alternatives $\surd(a\,x^2+2\,b\,x+c)$ or $(a\,x^2+2\,b\,x+c)^{\frac{1}{2}}$ overcomes these difficulties, and, in addition, can be set wholly or almost wholly by machine. Very similar remarks might be made about such an expression as $\frac{a\,x+b}{c\,x+d}$. A rule has to be cut to length to enable this expression to be printed, and, both above and below, the line in which the expression occurs has to be padded with "spaces." Eloquent testimony to the labour involved in composing the line containing the expression is provided by the fact that the compositor's charge for setting it is reckoned at six times the charge for setting a normal line of type. The use of the solidus or "shilling stroke," a standard symbol on the keyboards of type-composing machines, avoids the trouble, thus:—$(a\,x+b)/(c\,x+d)$. Many other examples might be quoted, but it would be futile to attempt in this place to cover the subject fully. To be quite frank, the pitfalls awaiting the unwary author are so numerous and in many instances so obscure that unless he is very closely acquainted with the art of typography he will almost certainly fall into them. On the other side we have a compositor who is not an expert mathematician and who can only follow meticulously the "copy" placed before him. The limitations of the printed page and the requirements of satisfactory typography introduce technical difficulties which the compositor has to resolve without affecting the sense of the mathematical argument. On the whole, after a lengthy experience of the subject, both from the mathematical and the typographical standpoints, we are inclined to feel surprise that mathematical compositions appear with as few serious errors as they do.

It is not easy to suggest any means whereby a radical improvement might be effected in the symbolisation of mathematics which would simultaneously meet the requirements of the mathematician and the printer. The average mathematician is about as familiar with the intricacies of type setting as the average printer is with the intricacies of mathematics. Yet until the two can meet and appreciate each other's arguments, it seems next to impossible that any improvement will be achieved. Ease of understanding and freedom from the slightest ambiguity are demanded by the mathematician. It is an unfortunate fact that many of the expedients which the printer would like to adopt to facilitate his side of the work undoubtedly have the effect of complicating the understanding of the expressions, and, all too frequently, of making their meaning ambiguous. The use of the solidus already referred to is a noteworthy instance of this nature. It can, as has been shown, greatly facilitate the printer's work, but, as all mathematicians know, it can readily be employed to convey a meaning quite different from that which is intended. Little, we think, can be hoped for from the adoption of conventions. A convention, for example, exists with regard to the solidus to the effect that it joins the adjacent symbols, not the adjacent expressions, that is to say, that $a+b/c$ means $a+(b/c)$ and not $(a+b)/c$. Among mathematicians such a convention might be useful, although it itself could lead to ambiguity in such an expression as $\sin\theta/n$. Among those who are called upon to apply the results of the mathematicians' labours, it might readily lead to a misinterpretation ending in a disaster. More and more, engineers are depending in their practical designs upon mathematical theories and calculations, which, by the nature of things, they are bound to take on trust. There are fly-wheels at work to-day which are safe only in the light of modern theory, which the theory of a few years ago would have condemned as dangerous. With a view to facilitating the dissemination of their results and to disseminating them in a manner permitting their easy and accurate understanding, it behoves mathematicians to study the typographical difficulties involved in the printing of their writings and to take thought how they may be reduced or removed.

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Steam Engine Trials—Ancient and Modern.

IF we go back to the early days of the steam engine we find that the efficiency was measured by what was called the "duty." Savery and Newcomen's engines and, later, the earlier engines of Boulton and Watt were employed only for pumping water, and a very practical measure of their abilities was the amount that they could raise one foot high for a chaldron or other measures of fuel. Thus we find Watt reporting that the Newcomen engines at Poldice raised 7 million pounds of water through one foot for a consumption of one bushel of coal. It is worth noting in passing that the bushel was not nationally standardised and not inconsiderable variations existed. By degrees the word "duty" came to have the same sort of compound significance as have knots for "nautical miles per hour," and we find in old records frequent references to engines of so many million duty. For example, the Watt engine which replaced two Newcomens at Poldice gave a duty of "26 millions." Later on Watt endeavoured to introduce a more scientific measure in which the basis was the pounds per square inch on the piston, the strokes—six was not uncommon per minute—and the length of the stroke, to indicate both the power of the engine and to give a means of measuring its duty by contrast with others. This was all very well for pumping, but it was useless, as far as efficiency was concerned, for rotative steam engines, and it was in consequence of their adoption that Watt made the historic investigation which led to the now international unit of horse-power. It would be pleasant to think of Watt establishing that unit under the inspiration of pure science. As a matter of fact, his motives were quite otherwise. His object was to conceal the dimensions of engines from potential customers whilst giving them an indication of the power that they could develop by comparing it with something quite familiar. It was not till a good many years after its first use by Boulton and Watt that horse-power became recognised as an arbitrary scientific standard of comparison. Even then its value was discounted by the fact that there were two horse-powers—the Nominal and the Real—just as there are still in motor car engineering. The nominal was, broadly speaking, about one-third of the actual power generated.

However, the establishment of horse-power was

the first real step towards the exact measurement of the efficiency of steam engines, and although the modern scientist prefers to speak in foot-pounds per minute, the larger unit is only eclipsed when the electrical engineer superposes his unit—the kilowatt-hour—to suit his convenience. It was a natural consequence of the provision of a scientific means of comparing the economics of engines that more precise tests came to be common. Amongst these competitive trials none perhaps raised greater general interest amongst engineers and more excitement amongst the contestants than those organised by the Royal Agricultural Society at its annual shows. These were first made in 1847 and were continued down to about 1890. Our memory is taken back to them by the reference to those of 1872 in "Sixty Years Ago" in our issue of July 15th. We fear there are few living who recall the yet earlier tests, but where a few old engineers gather together tales are told of contests which had all the elements of excitement of well-fought games. It is to be feared, however, that the sport was not always as "clean" as one could desire. They were rather rough customers—the drivers of agricultural engines—in those far-off times. They lived in country districts and not a few of them sprang from the soil and the rough play of the village tavern was carried on to the trial ground. But though physical violence is not unrecorded, it was generally by some more subtle device that the mechanics—not always without the knowledge of their principals—endeavoured to score off their opponents. A pinch of sand in the bearings was a favourite device, and the show engines, to provide against such a contingency, were as carefully guarded by night as a race-horse on the eve of a great event. Then, the competitors would not hesitate to take advantage of the judges if they saw a chance of doing so, and stories are told of a few pounds of coal hidden away, sometimes in the very fire-box itself. The care with which the engines were fired can scarcely be believed by those who never witnessed the trials. We referred in our "Sixty Years Ago" to James Moody, a celebrated performer, but in some cases the owner of the works would trust no one but himself. The usual arrangement for the trials was to give each competitor a certain weight of coals, and he who could keep his engine running longest on that weight, at the stipulated power, won. It is easy to imagine the anxiety with which the coal was examined, the care with which it was broken into convenient size with the production of little dust, and the jealousy with which bad stuff was picked out and thrown aside if it were not possible to beg replacement from the judges or acquire it from a neighbouring pile by surreptitious exchange on a weight basis! The firing itself was an art. No ordinary shovel was used; it was too gross altogether for the delicate manipulation required. It was commonly said of one celebrated builder who nearly always fired his own engines that he borrowed the once familiar gold scoop from his bank! A little coal was taken up on it. The fire door was whipped open, the coal shot in at the right spot, and the door slammed to again, literally before one could say Jack Robinson. The results attained were marvellous, and as we recorded in our issue of July 19th, 1872, one competitor kept the pressure gauge practically without appreciable movement for five hours!

Alas! that we shall never look upon their like again—those trials of two generations ago. The romance of engineering has been killed and science reigns in its stead. No longer are we content to see what an engine can do for a pound of coal, but we must know also what it doesn't do with it and must have a heat balance as long as your arm, and as difficult to follow as a profit and loss account, to display the thermal units which are sent back to Nature's store of energy without surrendering their quota for the use and convenience of man. Yet sometimes we wonder if there were not merits in the simple old plan, and sometimes we wonder if the tricks and devices of the show ground of sixty years ago have not their more subtle counterparts to-day.

Railway Accidents.

BRITISH railways always have been the butt for criticism—sometimes justly, sometimes unjustly. Undoubtedly, they have many offences to answer for, as they are by no means perfect. There are, however, some features on which they may pride themselves in that, therein, they not only have the best, but their excellence in those particular aspects is hardly challenged. They have, for instance, the finest passenger service in the world, whilst their goods trains run at a speed and with a punctuality that is not even approached by any other country. Their track and signalling is the finest, and nowhere is there a more loyal and on the whole a more contented staff. Above all these items, is their remarkable record for safety in travel. To that last point renewed attention is drawn by the railway accidents annual report for 1931 by Lieut.-Colonel Mount, the Chief Inspecting Officer of Railways. The report was published on July 22nd. Before we discuss it, we would relate certain facts that the recent disaster near Stafford has led us to ascertain, as we consider that they will bring out, with yet greater force, the very remarkable figures that Colonel Mount has marshalled in order to show the great safety of travel by railway. The preliminary points we would advance are that there are 23,000 locomotives, which run over 400 million miles a year, compressed within a total of 20,000 miles of railway. These engines are in the charge of 37,000 drivers, whose movements in travelling those 400 million miles and calling at a correspondingly large number of stations and engaging in shunting operations, are controlled by 27,000 signalmen, working in some 13,000 signal-boxes. All these men are, like ourselves, human, and liable to err; their thoughts may wander and their attention be distracted. In addition, although many of their movements are controlled in various ways, complete protection is not secured, and it is easy for a slip to be made that may lead to an accident.

Despite the frailty of human nature, which is shared by railwaymen in common with their fellow-beings, we find from Colonel Mount's present return that during the year 1931 there were only 406 collisions and derailments of every kind reported. Colonel Mount, in a summary that appears for the first time in the present report, further shows that 1606 million passenger journeys were made last year. Whilst it is to be regretted that eight of those passengers were killed and 414 were injured in train accidents, the proportion of the number of those unfortunate persons to the total number who travelled is so small that it is hardly possible to illustrate the contrast. In addition, 63 of the passengers lost their lives and 3697 were hurt in other ways than in accidents to trains. As the report, however, observes, "As usual, the large majority of total casualties [to passengers] . . . were due to misadventure or to carelessness or misconduct on the part of passengers themselves, the principal causes being entering or leaving trains in motion, crossing the line at stations, opening and closing of carriage doors, and falling from carriages or platforms. It would seem that education propaganda to induce greater care affords the best means by which the number of such accidents may be reduced." All these mishaps, arising out of the carelessness of passengers, count, however, as accidents, and mar the credit of the railway companies. Despite their inclusion, and with the addition of 59 "other persons"—people who are neither passengers nor servants—who were killed and 161 injured (of which figures 38 and 40 respectively related to persons knocked down at level crossings), together with 159 servants killed and 2714 injured, the total fatalities on the railways last year averaged 0·7 for every million train miles, whilst the non-fatal cases averaged only 17 per million. These figures are very remarkable, but they become more so—and thereby justify the pride which British railways may take in this matter—when it is seen in Colonel Mount's summary that they are not exceptional, but are of the same order as has prevailed during the eleven years for which corresponding figures are given. A yet more creditable feature is the growing decrease in accidents to railway employees. The railway service is generally looked upon as a dangerous occupation. Whilst not disposed to challenge that opinion, we cannot resist the temptation to say that reference to the accident returns for 1901 shows that, compared with 146 servants killed and 2633 injured last year in what are known as "movement" accidents, there were 503 such accidents with fatal results and 4087 non-fatal exactly thirty years ago. Colonel Mount's summary does not go back as far; he is content with the five-year period 1920–24, and there the comparison shows a decrease of no less than 89 killed and 804 injured. This comparison with these later years may prompt the suggestion that the better results are attributable to the less traffic carried, as well as to a drop of 90,000 in the number employed. It should therefore be observed that whilst the business done is much less than in 1920–24, the number of trains must, in order to retain the business remaining, be maintained; in fact, the 411·7 million train miles of last year compared with 368·7 millions a year in the 1920–24 period. On this point of accidents to railway servants, the Chief Inspecting Officer observes: "The principal improvement concerns men working, walking, or standing on the permanent way, and it encourages the hope that continued educational endeavour is having more effect in fostering the safety instinct." But for his modesty, Colonel Mount might have given himself and his own department some credit for a big share in the "continued educational endeavour."

Naturally, one wonders if the remarkable record as to accidents involving passenger trains, can, like those to railway servants, be further reduced. To achieve that would be difficult. Whilst the eight passengers killed last year in train accidents compared with one in 1930 and three in 1929, the average for 1925–29 was eighteen a year, and for 1920–24 it was eleven. Although, as already said, there were 406 collisions and derailments last year, the Ministry of Transport did not think it necessary to inquire into more than eighteen accidents. The object of those investigations is less to determine the cause and to allocate the blame than to advise what should be done to prevent similar mishaps in the future. The Act of 1871, under which such inquiries are held, orders the inspecting officer to "make any observations thereon" and the consequent reports contain therefore recommendations towards that end. In fourteen of the eighteen reports last year, recommendations were made, and we read that in eleven instances they were wholly or partially adopted, and in the remainder the recommendations were under consideration by the companies concerned. As illustrative of the beneficial effect that follows the inquiries of Colonel Mount and his colleagues, we would say that, as regards the serious accident at Carlisle, the annual report observes: "Speed indicators have been fitted experimentally on certain express engines, and permanent restrictions at curves and junctions are being reviewed, with the object of providing further speed restriction boards when considered necessary or desirable." In respect of the yet more serious derailment at Leighton Buzzard, we read that: "As a result of this accident, engines of the 'Royal Scot' and other classes are being fitted with deflector plates at the side of the smoke-box, to reduce, as far as possible, obstruction of vision from the footplate by smoke and steam."

OBITUARY.

DR. G. K. BURGESS.

PHYSICISTS and metallurgists in this country have heard with great regret of the death of Dr. G. K. Burgess, lately Director of the United States Bureau of Standards at Washington, at the age of fifty-eight. Through his physical and metallurgical researches and the frequent visits which he paid to this country, the late Dr. Burgess was well known to his colleagues here, and those who had occasion to come into personal contact with him appreciated his genial personality and his constant readiness to be helpful in every possible way.

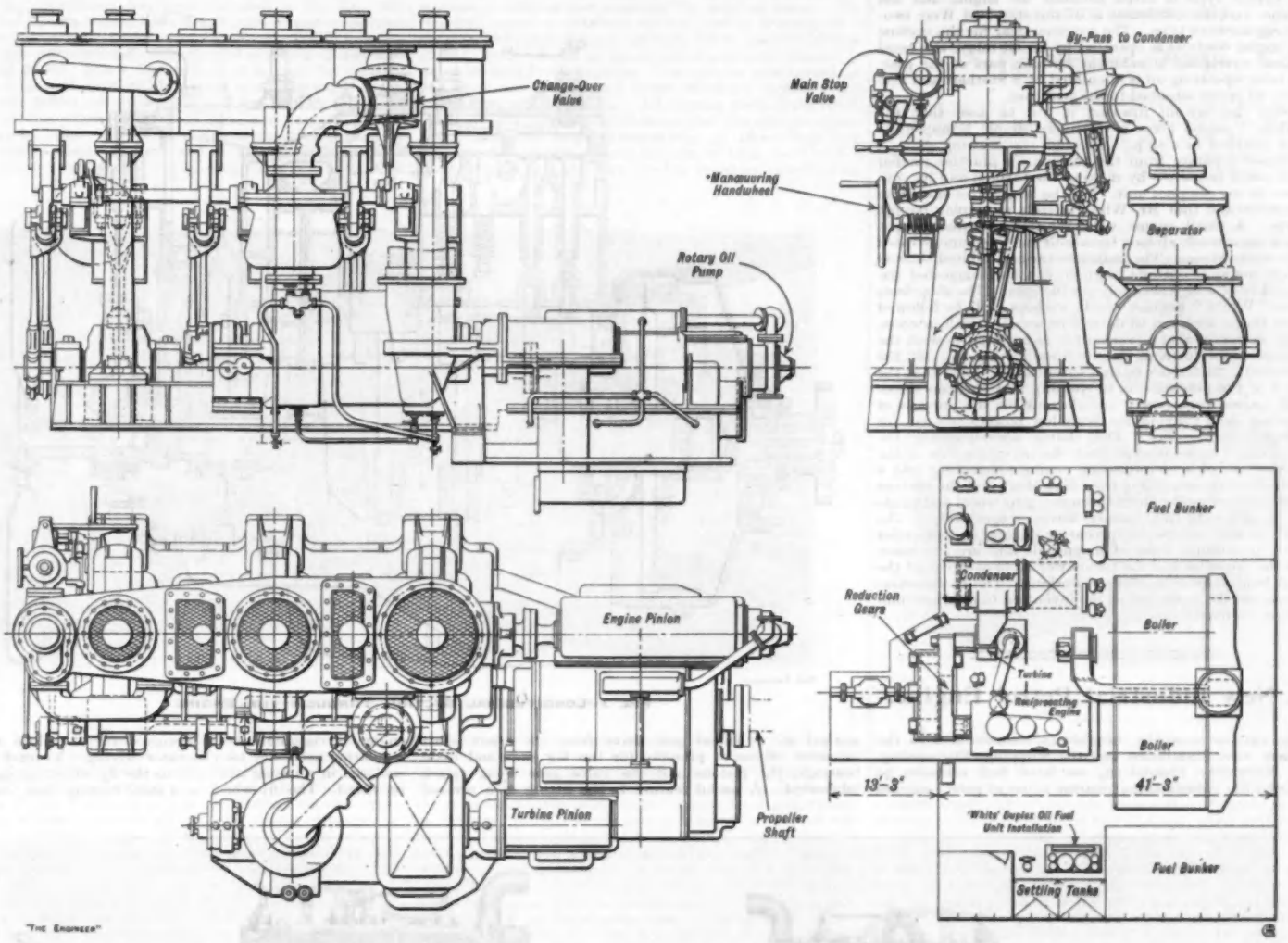
Dr. Burgess received his scientific and technical education at the Massachusetts Institute of Technology, and earned his Doctor's degree at Paris. Later he received honorary degrees from two American Colleges. He began his career as a teacher of physics at the Massachusetts Institute of Technology, the University of Michigan, and the University of California. He first became connected with the United States Bureau of Standards in 1903 as associate physicist and in that capacity carried out important researches on high-temperature measurements. He was appointed Chief of the Division of Metallurgy at the Bureau of Standards in 1913, and finally in 1923 he was appointed Director of the Bureau, in succession to the late Dr. Stratton, who had at that time resigned from the Bureau of Standards to become President of the Massachusetts Institute. While Head of the Metallurgy Division, Dr. Burgess took an active part in the metallurgical work of America, becoming President of, among other bodies, the American Society for Steel Treating and the American Society for Testing Materials. Under his supervision a number of important researches were carried out in the Metallurgy Division at the Bureau of Standards, including notably the work of Merica, Waltenberg, and Scott on the age-hardening of aluminium alloys.

Metallurgists will particularly regret that Dr. Burgess, who had been so closely identified with their work, was only able to exercise his functions as Director of the great American National Laboratory for so relatively short a period.

"THE METALLURGIST."

THE July issue of our Supplement, THE METALLURGIST, which appears with this issue of THE ENGINEER, deals, in its leading articles, with three important questions. Under the heading "Stress Raisers," the various defects—both exterior and interior—which are known to cause local concentration of stress are briefly discussed, but it is pointed out that similar effects appear to be produced by causes which are not yet fully understood. The article on "Users of Metals" deals with the importance of industries other than those of an engineering nature as actual or potential consumers of metals, both ferrous and non-ferrous. In regard to "Written Discussion," it is pointed out that discussion by correspondence in the columns of a technical periodical may usefully supplement verbal and written discussion before our institutes and societies, and contributions of this kind—provided that they are brief, non-polemical and, if possible, constructive—are invited. Attention is called to another article on "The Nomenclature of Hardening," which contains suggestions upon which comments are invited. Other articles deal with "Abnormality in Steel," "Aluminium Bronze," "Magnetic Alloys," "Temper-hardening of Austenitic Corrosion-resisting Steels," "The Hardness of Chromium," "Iron Tube Manufacture by Electro-deposition," and "Chromium Plating from Chloride and Sulphate Baths."

520 I.H.P. "WHITE" COMBINED MARINE ENGINE



The "White" Combined Marine Reciprocating Engine and Exhaust Turbine.

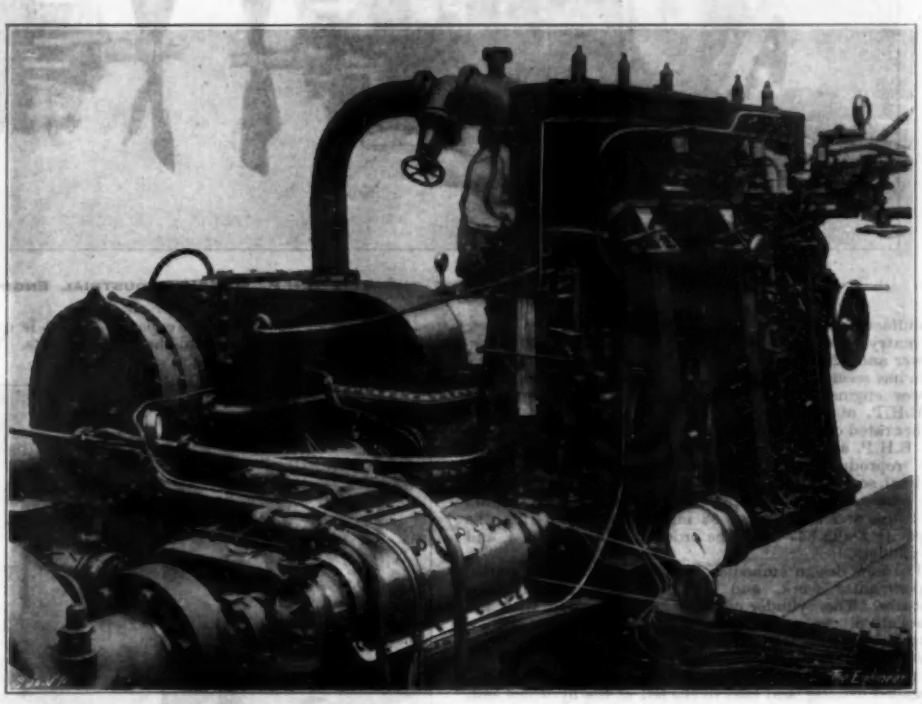
THE demonstration trials of the "White" patented combined reciprocating steam engine and exhaust turbine for marine propulsion, which have been carried out at the St. Peter's Works of R. and W. Hawthorn, Leslie and Co., Ltd., during the last two weeks, have been followed with keen interest by shipbuilders and marine engineers. Last week we were invited to inspect the engine, which was running under shop trial conditions, coupled to a water brake. The actual technical trials which have been carried out over an extended period were made under the personal supervision of Engineer-Commander C. G. Hawkes, R.N. (Ret.), Professor of Engineering at Armstrong College, Newcastle-upon-Tyne, and include, we understand, a wide range of tests both for steam consumption and for thermal efficiency under differing steam conditions. These tests, we hope, will form the basis of a later article. Meanwhile we give herewith an illustration of the new engine, together with a general arrangement drawing and a lay-out arrangement of the engine in a ship.

The "White" combined engine is essentially a high-speed reciprocating non-condensing engine which is coupled to the propeller shaft through single-reduction gearing with an exhaust turbine arranged to drive the same main wheel through double-reduction gearing. It was built to the designs of the inventor, Mr. W. A. White, of White's Marine Engineering Company, Ltd., of Hebburn-on-Tyne, by Smith's Dock Company, Ltd., of South Bank, while the Parsons reaction turbine with eight blade rows and an outside casing diameter of about 3ft. 6in., was built by Hawthorn, Leslie and Co., Ltd. The gearing was cut by the Power Plant Company, Ltd., of West Drayton, Middlesex, and includes that firm's patented "carrier ring" flexible coupling with a "White" patented resilient drive comprising a built-up plate type main gear wheel with an arrangement of springs for absorbing shock and giving a smooth drive. The two pinion shafts for the main engine drive and the second pinion of the turbine are both of the standard quill drive pattern.

The engine was arranged for testing by Mr. White in conjunction with the engine department staff of Hawthorn, Leslie, and was supplied with steam at 250 lb. per square inch from a water-tube boiler, a gas-fired superheater being employed to deliver the steam at a total temperature of about 500 deg. Fah. at the high-pressure cylinder stop valve with a pressure of about 225 lb. per square inch. As will be gathered from the accompanying engraving and drawing, the engine follows generally accepted marine reciprocating practice in its main scantlings and in the Stephenson valve gear arrangement. The high-pressure cylinder is fitted with a piston valve, while on the intermediate and low-pressure cylinders patented slide valves of the Andrews and Cameron balanced pattern are employed, all the glands being packed with United States packing. The cylinder diameters are: high-pressure, 10in.; intermediate-pressure, 14in.; and low-pressure, 18in., with a common stroke of 13in. The designed running speed is 260 r.p.m., corresponding to a propeller speed of 112 r.p.m., and at this speed the output of the reciprocating engine is, Mr. White informed us, about 310 I.H.P., with a turbine output of about 210 I.H.P., making a total of approximately 520 I.H.P. A maximum power of about 650 I.H.P. can be attained. On the occasion of our visit the engine was running quietly at 270 r.p.m. and the pressure readings at various points were: high-pressure stop valve, 220 lb.; intermediate-pressure receiver, 86 lb. per square inch; low-pressure receiver, 33 lb. per square inch; and exhaust to the turbine at atmospheric pressure. The weight of the engine and turbine complete is about 10 tons.

The measured steam consumption was given to us as 8·4 lb. per I.H.P. hour, which represents a saving of 36 to 38 per cent. compared with the normal practice for a triple-expansion engine of the same power. It is expected that with a larger engine of the cargo steamer type, having a designed output of, say, from 1500 to 1800 I.H.P., specially designed for that power, a steam consumption of about 7·6 lb. per I.H.P. hour will in practice be realised.

The general arrangement drawing reproduced herewith shows clearly the change-over valve, the steam separator, and the gearing lay-out. The change-over valve allows the engine to exhaust directly into the condenser instead of to the turbine, and the patent further provides for the automatic operation of the change-over valve in the



VIEW OF ENGINE AS ARRANGED FOR SHOP TRIALS

process of reversing the engine. The turbine is designed to run at 4600 r.p.m. and the gear ratio for the turbine pinion is 8·5 to 1, that for the second pinion 4·84 to 1, and that for the engine pinion 2·31 to 1. An oil separator of the Vortex type is fitted between the engine and the turbine, and the condenser is of the standard Weir two-flow regenerative type. The governor gear for the turbine and engine controls is operated by an oil relay, the usual Aspinall overspeed attachment forming part of the gear. The relay operating oil is circulated by a Stothert and Pitt rotary oil pump attached to the gear case.

From the lay-out drawing it will be seen that the "White" engine gives a relatively simple arrangement when installed in a ship. Although the drawing shows a condenser separate from the turbine, in practice further space could be gained by making the turbine and its condenser in one compact unit. For the larger sizes of engines we understand that Mr. White intends to employ poppet valves. A small engine with White's patented poppet valves has actually already been built and was demonstrated to us under steam. The indicator cards exhibited showed a wide range of cut-offs down to 0·4 and suggested the possibility of a high economy for the gear. The shop tests of the "White" engine, which, we hope, will be followed in due course with sea trials, will be awaited with interest.

The design of this power unit is in accordance with the particulars set forth in Patent Specification No. 362,255 (amended). Reference to that specification shows that the object of the invention is to simplify and cheapen three-shaft marine type power installations for the purpose of adapting them for comparatively low powers as used, for example, in trawlers. The claims accompanying the specification make it clear that the invention lies in the combination of a reciprocating engine exhausting into a turbine and in connecting the crank shaft and the turbine shaft to the propeller shaft through a gear wheel and single and double-reduction pinion drives respectively. The speeds of the turbine, reciprocating engine, and propeller are in descending order of magnitude and are so chosen that the propeller and the two power units each run at the speed best adapted to efficient working. The specification also covers the extension of the invention to internal combustion engines.

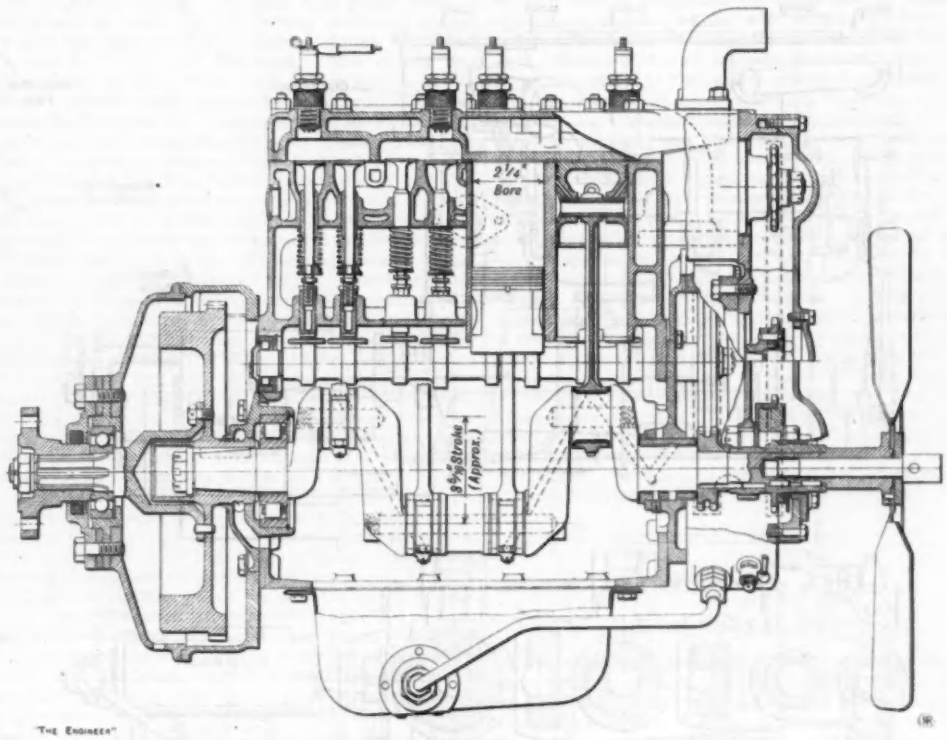


FIG. 3—LONGITUDINAL SECTION THROUGH THE ENGINE

A New Industrial Petrol Engine.

ON various occasions, notably in connection with the Buenos Aires Exhibition and the Shipping, Engineering, and Machinery Exhibition, we have had occasion to describe the industrial and marine types of petrol engines manufactured by Morris Motors, Ltd., of Gosford-street, Coventry. Encouraged by the success of its 10–20 horse-power and 12–24 horse-power industrial type engines, the firm has recently introduced a new model, the 5–12 horse-power engine, which has a designed output range of 4 B.H.P. at 800 r.p.m. to 13·5 B.H.P. at 2800 r.p.m. Other rated outputs are 5 B.H.P. at 1000 r.p.m. and nearly 12 B.H.P. at 2000 r.p.m. Two side views of the engine are reproduced in Fig. 1, while Fig. 3 is a longitudinal section through the cylinders. The engine is of the four-cylinder, four-stroke type, with a bore of 57 mm., or 2¼in., and a stroke of 83 mm., or nearly 3⅜in., the capacity being 847 c.c. The order of firing is 1, 3, 4, and 2 cylinders.

The new design embodies the result of twelve months' experimental work, and contains some entirely new features. The cylinder casting, in conjunction with the top half of the crank case, is a monobloc unit with a detachable head, the water-cooled cylinder jackets being carried well down the liners. The crank shaft is carried in two main bearings, that to the right being a white-metalled bearing, and that to the left at the fly-wheel end, a high-duty roller bearing. The crank shaft itself is a single-piece drop forging, drilled for lubrication, and balanced both statically and dynamically. Drop forged steel connecting-rods are employed, which are also balanced both for weight and centre of gravity. The pistons are made of die cast aluminium alloy, and are ground to a high finish. They carry three piston-rings, the lower ring acting as a scraper ring with an oil return arrangement. The gudgeon pin is of the hollow type, and is held in the split small end of the connecting-rod. Attention may be called to the strong cam shaft, which is supported in the cylinder block in ball and roller bearings. At the end of this shaft there is a duplex chain drive from the crank shaft, with an auxiliary drive to the magneto. The valve gear follows closely the maker's standard design, the tappets being fitted with adjusting screws, and replaceable cast iron valve guides being provided. A gear type pump worked by a helical gear drive from the crank shaft furnishes oil under pressure for the big ends and main bearings, the pistons and the valve gear being splash lubricated. A useful feature is the fitting of a pressed steel oil sump of about 4 pints capacity, which is quite easily removed to give access to the running parts. The engine is usually supplied with a four-bladed fan, as shown, and a thermo-syphonic water-cooling system, but, if desired, a gear pump can be fitted for circulating the water. The views of the engine reproduced in Fig. 1 show the arrangement of the Lucas magneto, the governor, and the Smith single-jet carburetter. The governor is of a new type with arrangements for adjustment, while the engine is running, and is designed for the close speed regulation necessary for generator driving. A clutch gear enclosed in a casing attached to the fly-wheel casing can be fitted. The fly-wheel is a steel forging, and carries the gear ring which engages with the starting pinion.

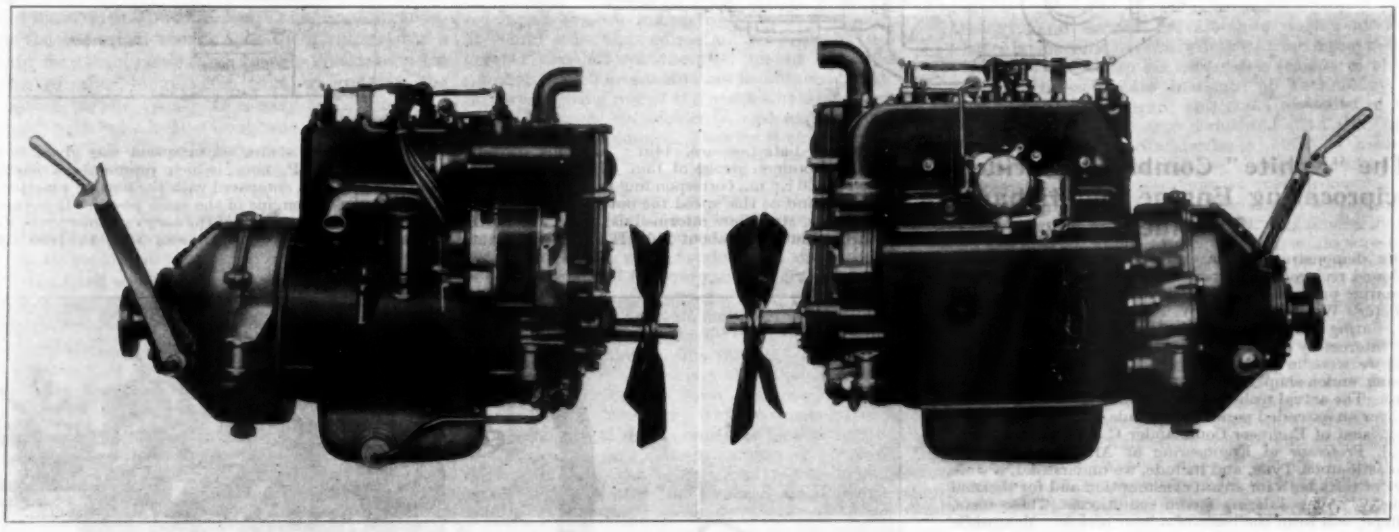


FIG. 1—SIDE VIEWS OF THE 5-12 B.H.P. MORRIS INDUSTRIAL ENGINE WITH CLUTCH DRIVE

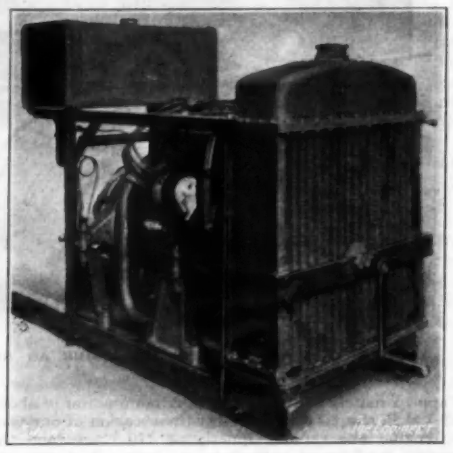


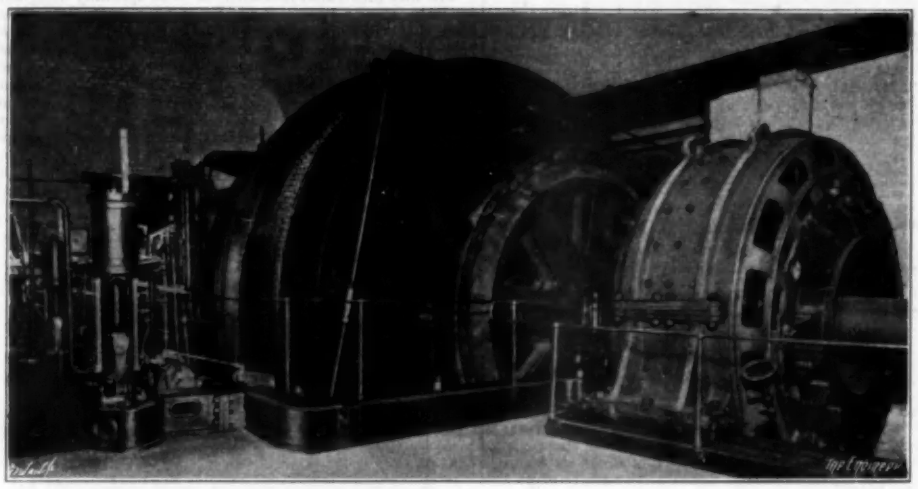
FIG. 2—SELF-CONTAINED ENGINE UNIT

The coupling is splined to the shaft and, as an alternative to this coupling, a three-armed spider for carrying a Hardy disc can be supplied. Reduction gears having a ratio of 1·954 to 1 can be fitted to both the clutch and non-clutch designs, and the coupling arrangement is such that the gear can be fitted in eight different positions relatively to the crank shaft. In order to avoid the necessity of slinging, a lifting loop is fitted on the engine. We show in Fig. 2 a complete engine unit mounted on bearers in a steel frame, complete with radiator, fuel, and water tanks, ready for coupling up for any purpose. For export overseas, modified cooling and carburetter arrangements are provided for. The engine we have described is now well in production, and the usual arrangements have been made for obtaining spare parts from the firm's service depôts.

THE efficiency of a water-tube boiler fired with pulverised coal was observed by E. Pfleidererer, as described in the *V.D.I. Zeitschrift*, and was ascertained for several qualities of fuel. It was 85 per cent. when using flaming coal dust, 5 per cent. loss being due to chimney dust. A mixture of 30 parts of flaming coal with 70 parts of flameless coal reduced the efficiency to 78–80 per cent., with a chimney dust loss of 8–10 per cent. During one trial with coal dust containing 7 per cent. volatile matter and 15 per cent. ashes, the chimney dust loss amounted to 20 per cent. The dust caused serious complaints of nuisance. Cyclone separators removed only 25 per cent. of it. Water spraying effected an improvement up to 95 per cent., but the fans and ducts wore out very quickly, owing to acid and grit. All these parts were then covered with rubber, and the trouble ceased.

A Large Electric Winder.

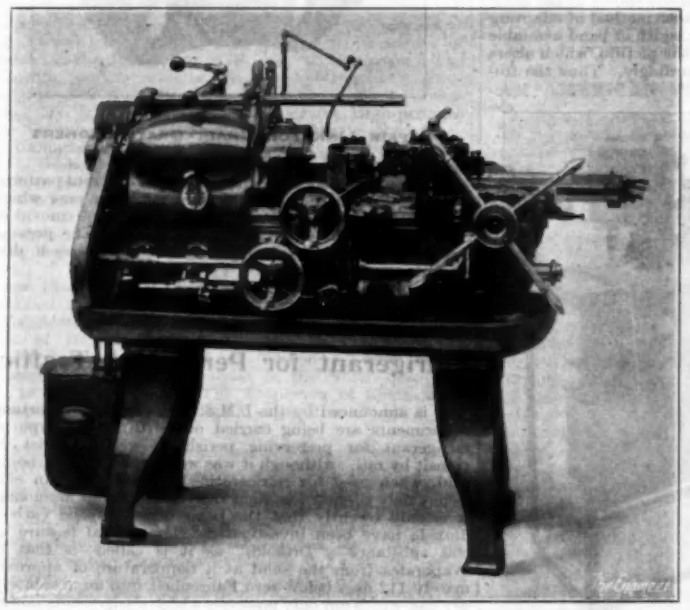
THE double-drum electric winder shown in the accompanying illustration has been installed in the No. 16A shaft of Crown Mines, Ltd., South Africa, and is claimed to be the largest winder working on the Ward Leonard principle underground. Situated at a depth of approximately 3200ft. below the surface, it is used for winding from a vertical shaft which is sunk to an additional depth of about 3600ft., and when the rock has been raised to the level of the winder it is discharged and brought to the surface by other equipment. Each of the skips hoisted by the winder weighs 4½ tons and is capable of handling a load of 10 tons, which usually consists of 8 tons of rock and 2 tons of moisture. With this load the winder is capable of completing the full wind in eighty-nine seconds. With eleven seconds between winds the total weight wound per hour is 360 tons, or 288 tons of rock. Each of the two drums of the winder is of the "cylindro-conical" type, having a small diameter of 12ft. and a large diameter of 24ft. One drum is keyed to the shaft, whilst in order to allow for rope adjustment, the other is coupled to it through a multi-toothed clutch operated by compressed air. The drum shaft is driven by two D.C. motors, one at each end, each rated at 1425 H.P. at 39·8 r.p.m. and designed for partial building up on site. When utilising the large-diameter drum the equipment hoists men with a total weight of 9000 lb. from a depth of 3600ft., the weight of the cage being 8000 lb. The trip takes 65½ seconds and there are 25 seconds between the winds. The motor generator set for operating the winder consists of a 2500 horse-power 2000-volt 50-cycle three-phase induction motor driving two 1050-kW 1100-volt D.C. generators and an exciter at a speed of 492 r.p.m. All the electrical equipment was supplied by the B.T.H. Company, of Rugby.



UNDERGROUND DOUBLE DRUM ELECTRIC WINDER

Two New Lathes.

Two new lathes, illustrated herewith, have recently been introduced by H. W. Ward and Co., Ltd., of Birmingham. They are the No. 2A capstan lathe with single-pulley headstock and the No. 2E motor-driven capstan lathe. In the first-named machine, which is suitable for either chuck work or production from bar, and which can be equipped with a pneumatic or hand-operated chuck, the headstock is of a new type, allowing fast speed changing through friction clutches which run in oil. Six spindle speeds in each direction are available, and, being arranged in three groups, two forward and two reverse speeds are at instant command without the necessity for moving gears. The required range is obtained by the partial rotation of a lever on the front of the headstock, which operates sliding gears. Incorporated in the speed-changing movement is an automatic brake motion. The spindle is mounted on combined ball journal and thrust bearings, together with heavy duty roller bearings. All rotating parts of the headstock are also carried on ball and roller journals, provision being made for ample lubrication. A 1¾in. clear hole through the spindle allows the use of 1½in. bars, and a screwed spindle nose with double registers provides for the rapid change of chucks and fixtures. The speed range for general work is from 114 to 1008 r.p.m., whilst for high-speed work an alternative range of from 171 to 1512 r.p.m. can be obtained. The situation of the single pulley makes the machine equally suitable for driving from a line shaft or directly by an electric motor through a belt or vee ropes. A coolant pump is provided with a hand-operated clutch to disengage the pump should the work in hand not require a cooling medium. A useful feature is the automatic feed to the capstan slide; the motion is driven from a feed shaft along the front of the machine through a gear-box attached to the capstan rest. Two rates of feed—80 and 165 spindle revolutions per inch of capstan slide travel—are obtainable by a simple change device at the right-hand side of the gear-box attached to the capstan rest.



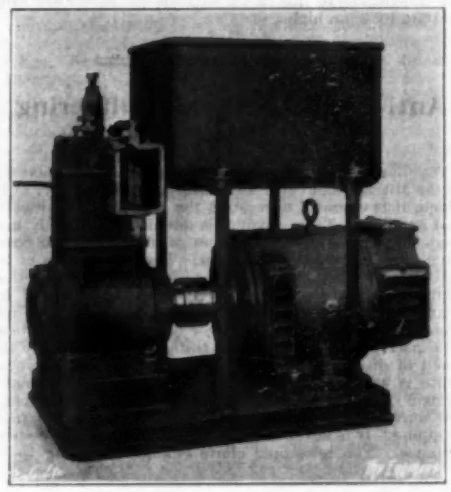
CAPSTAN LATHE WITH SINGLE PULLEY HEADSTOCK

When the lathe is intended for bar work an automatic chuck can be fitted which is designed for rapid and accurate chucking of bars and tubes or short pieces for second process work. The operation of this chuck is very simple, one lever only being used for both gripping and releasing.

The No. 2E capstan lathe has been developed to meet the demand for a machine having an electric drive and capable of providing speed changes with great rapidity. The spindle actually forms the armature shaft of the motor, the rotor being directly attached to it. The stator is mounted in the lathe headstock, and on a suitable A.C. supply four speeds can be obtained in both directions, the standard machine being arranged for a three-phase 50-cycle supply of between 400 and 440 volts. On this voltage the four speeds available are 445, 705, 955, and 1450 r.p.m. The hole through the spindle is 1⅝in. in diameter and the lathe can be fitted with the makers' 1¾in. automatic chuck and a bar feed motion. When required, the coolant pump is of the electric type. Other features of both new models, such as the sliding saddle and cross slide, capstan rest, &c., are similar to the standard fittings on the makers' ungeared type of capstan lathe.

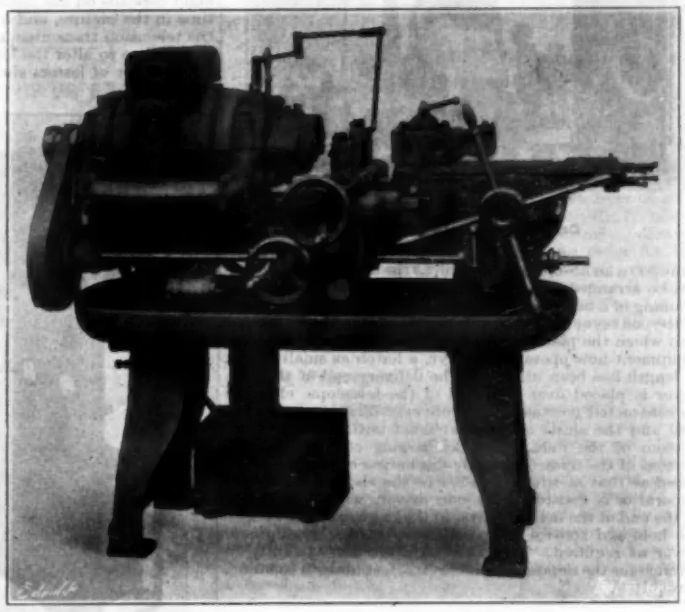
A High-Speed Pump.

IN our issue of June 10th we described and illustrated a self-indicating testing machine made by W. and T. Avery, Ltd. Some mention was then made of the high-speed hydraulic pump supplied by the Leeds Engineering and Hydraulic Company, Ltd., of Rodley, near Leeds, for use with the testing machine. This pump, illustrated by the accompanying engraving, embodies certain interesting features and deserves some further description. It has three rams, ½in. diameter by ⅝in. stroke, operated by a crank shaft, direct coupled to a 1 H.P. electric motor running at a constant speed of 750 r.p.m. The maximum working pressure with all three rams in operation is 2750 lb. per square inch. Two of the rams, however, can be unloaded by the use of the small hand-operated cam wheel to be seen on the top of the pump casing. This cam lifts the suction valves of the two rams concerned and in this condition the pump can deliver against a pressure of 4500 lb. per square inch. For this particular pump an arrangement was fitted such that the third ram could be loaded or unloaded automatically. The solenoid attached to the side of the casing was electrically connected with the controls of the testing machine so that a steady load upon the test piece could be maintained for long periods.



HIGH-SPEED PUMP

The general construction of the pump may be readily understood by referring to the engraving. The pump body, which is a solid steel block, is firmly bolted to a cast iron crank case enclosing the three-throw crank shaft, which runs in roller bearings completely immersed in oil. The rams are of case-hardened steel, ground and lapped to a fine sliding fit in phosphor-bronze bushes, which are pressed into the pump block by hydraulic power. There are no packings, the rams being of a sufficiently fine fit to hold the highest pressures. A cast iron suction cover is bolted to the top of the pump block and connected to the suction tank, which contains a special quality of oil used as the hydraulic medium. The suction and delivery valves are made of high-quality alloy steel. The closure of the valves, the makers state, is not in any way dependent on



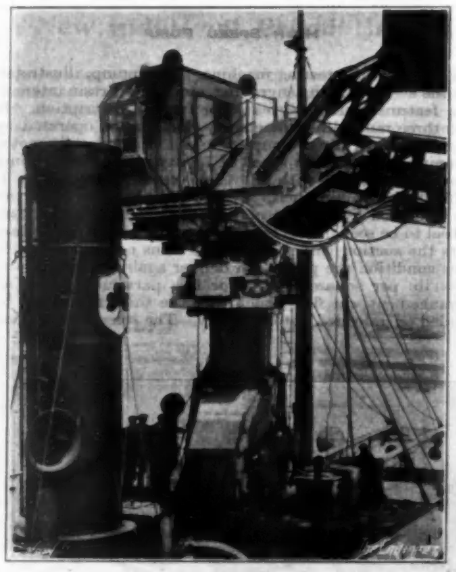
MOTOR-DRIVEN CAPSTAN LATHE

the viscosity of the oil, as is the case with the sleeve valves which are fitted to many other forms of high-speed pump. This arrangement is advantageous, in that the slip is constant, and is not dependent on the pressure and temperature of the oil. This factor is very important when the pump has to provide a uniform traverse to some part of a machine, since any increase in the resistance will increase the pressure, thereby reducing the effective delivery of the pump and consequently reducing the speed of traverse. With this pump, it is claimed, the traverse is uniform irrespective of pressure, with the exception that when the maximum pressure is reached the relief valve operates so as to prevent damage to the machine.

Similar pumps are made by the company in various sizes. We are informed by the makers that the largest pattern which they have so far delivered has 1¾in. diameter rams by 1¼in. stroke. It runs at 720 r.p.m. and is capable of developing a pressure equal to 3 tons per square inch. The dimensions of this pump without the motor are 21in. by 18in. by 39in. high.

Anti-Breakage Coal Bunkering Plant.

We illustrate herewith a bunkering plant manufactured by the Mitchell Conveyor and Transporter Company, Ltd., which, it is claimed, overcomes the familiar difficulties of coal handling. This conveyor is designed to embody in a single apparatus the advantages of anti-breakage, trimming, and high-speed operation. The importance of its anti-breakage action will be realised from the fact that additional values up to 3s. a ton can be obtained by delivering the coal to the consumers' bunkers in an unbroken condition. The conveyor is very rapid in action, its capacity to load being, it is stated, limited only by the speed of discharge from the coal trucks. The conveyor chute is at all times kept full of coal by an automatic electric control. All the time the coal is moving through the conveyor, it is either being lifted or protected from dropping. It is never allowed to fall through any vertical distance. The telescopic chute enables trimming to be

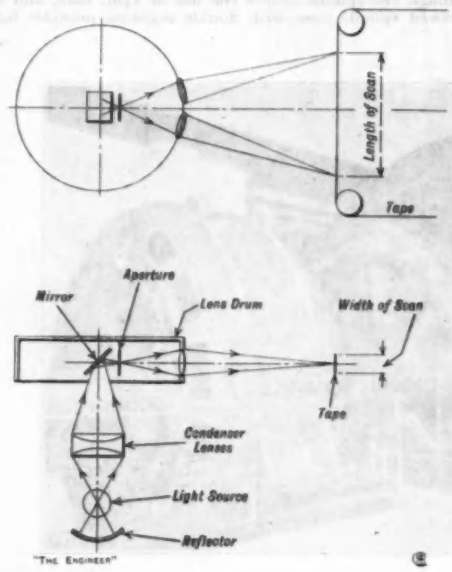


COAL BUNKERING PLANT

reduced to an absolute minimum, as the discharge conveyor can be arranged so as actually to feed the coal under the coaming of a bunker or a hold in all directions. The length of the conveyor is limited only by the size of the hatchway into which the plant has to be lowered. With a conveyor equipment now operating at Ayr, a hatch as small as 8ft. in length has been utilised. The delivery end of the conveyor is placed over the head of the telescopic chute in its contracted position. The conveyor fills the chute with coal and the chute is then extended until it reaches the bottom of the hold. The discharging conveyor at the bottom of the telescopic chute discharges coal at the same speed as that at which it is fed to the chute. The whole apparatus is controlled by one driver, who is stationed at the end of the delivery arm, so that he can see down into the hold and control the position of the discharging conveyor as required. It is thus easy for him instantly to arrange for the deposit of coal several feet under a coaming, if required.

News by Television.

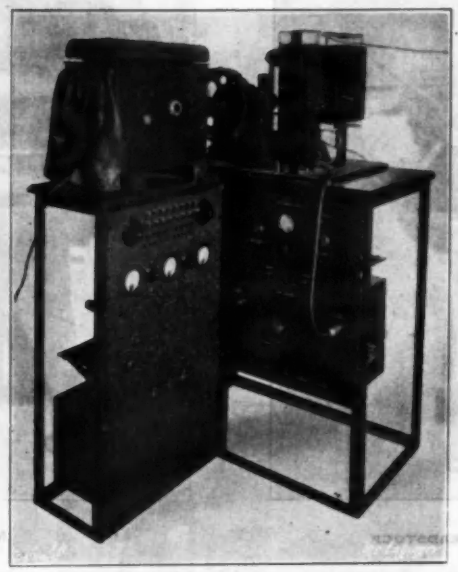
In a recent announcement regarding the lines on which its television research is proceeding, the Marconi Company indicates as one of its objects a departure from the stereotyped head and shoulders picture television, and stresses the fact which has to a certain extent been overlooked, that television has a future outside as well as inside the amusement field. It is stated that some applications may not necessarily involve the use of wide frequency bands such as are deemed necessary for good picture television, and for these applications ordinary commercial wavelengths can be employed for radio transmission; for certain classes of work, a medium long wave of 1000 m. provides sufficient band width, free from interference. The accompanying half-tone engraving shows an apparatus which has been developed by the Marconi Company for the commercial transmission of news. It is designed to transmit images of a moving tape on which characters are printed by a special typewriter. The light source is a 1000-watt gas-filled metal filament projector lamp mounted vertically with a reflector behind it, the light passing through a spherical condenser lens system on to a reflecting mirror and an aperture, and thence through a system of lenses mounted in a spiral on a lens drum. The optical system is shown in the accompanying diagram. There are fifteen such lenses on the drum and the picture repetition frequency that corresponds to the speed of the drum is twenty per second. A sharp image of the aperture is projected by each lens on the tape and is swept over it by the motion of the lens drum. The tape, which can be



OPTICAL SYSTEM OF TELEVISION TRANSMITTER

driven at either of two speeds, is carried vertically between two rollers, the bottom one of which is driven through suitable gearing by the same motor as drives the lens drum. Behind the tape is mounted the photo cell and photo cell amplifier, both of which are contained in a single shielded unit. The lens drum driving motor is maintained at constant speed by means of a synchronous motor which is controlled by a tuning fork mounted in the bottom of the frame under the lamp-house. Above the tuning fork is the fork amplifier unit, and above that is the control unit for the whole system. The frame which supports the lens wheel and tape drive carries two panels, the lower one carrying the line amplifier and the other the synchronising circuit which sends out a special signal with the picture signal for the purpose of keeping the receiver scanning motor in step.

In this type of transmitter the necessary frequency band depends on the number of letters shown at the same time in the picture, and a convenient method of adapting the television transmission to any width of band available is therefore to alter the length of the picture, which alters the number of letters shown accordingly. Thus the fre-



TELEVISION NEWS TRANSMITTER

quency band required by the apparatus described is 13 k/cs., but by reducing the distance between the lenses on the drum which shortens the picture length and reduces the number of letters shown, this band width can be reduced to any convenient value.

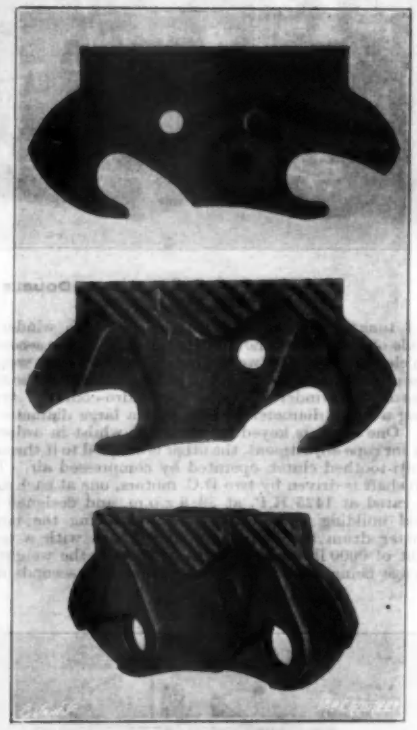
The receiver shows a long narrow picture having a size dependent on the power of the modulated light source, and with existing facilities pictures can be obtained from a few inches in length up to several feet.

It is believed by the Marconi Company that apparatus of this type could replace with advantage the microphone and loud speaker for the broadcast of certain news items, and would be much appreciated by the general public as an alternative method of news reception.

A Quick Repair Link for Stokers.

It may sometimes happen in a boiler-house that it is inconvenient to stop a chain grate stoker for the period necessary to replace a broken link. This generally involves the necessity of withdrawing at least two link rods, and, as is now frequently the case with the combination of fine fuel or a non-caking fuel and forced draught, the conditions are such as to render it inadvisable to operate the stoker with a hole in the grate, resulting from removing a broken or burnt link. Therefore, a quick repair link is of special use for replacing a broken or burnt link as a temporary measure, without stopping the stoker, thereby allowing the plant to continue working until a convenient time arrives to shut down for the period necessary for effecting permanent repairs.

The link illustrated herewith has been specially designed by Babcock and Wilcox, Ltd., for this purpose. It will be seen that the link is divided, and that both halves are exactly the same. In making the repair, all that it is necessary to do is first to cut out the broken link without removing the link rods, taking care that all the broken pieces are removed from the grate, and then place the link in position on the link rods, each half being fitted separately. When complete, as shown, the two halves are automatically locked together on the link rods and act in the same way as the standard link. Quick repair links in the past, it is pointed out, have suffered from a number



REPAIR LINK FOR CHAIN-GRATE STOKERS

of disadvantages, such as a multiplicity of different patterns and the introduction of mild steel retaining pins which have been prone to burn, while frequently the removal of pins has been the cause of some difficulty. The present design, it is claimed, completely overcomes such disadvantages.

Refrigerant for Perishable Traffic.

It is announced by the L.M.S. Railway that important experiments are being carried out with a new type of refrigerant for preserving perishable goods whilst in transit by rail. Although it was well known that carbonic acid, when used for refrigerating purposes, had an efficiency only slightly less than that of anhydrous ammonia, it is only recently that the possibilities of solid carbon dioxide have been investigated. The special feature of this substance—"Drikold," as it is called—is that it evaporates from the solid at a temperature of approximately 112 deg. below zero Fahrenheit into an absolutely dry gas, which not only possesses a high refrigerating power but also acts as a destroyer of certain bacteria which survive below the melting point of ice. The L.M.S. Railway is chiefly concerned with the transport in door-to-door containers of perishable goods, such as frozen and fresh fish, which require protection from the atmosphere. Each container used for the experiments has fitted into the roof four insulated chambers specially designed for the reception of the solid carbon dioxide, and for the maintenance of the contents at the required low temperature. Experiments have already been made, ranging from mere chilling to hard freezing, *i.e.*, maintaining a temperature of 15 deg. to 20 deg. below the freezing point of water, such goods as salmon, smoked fish, and dried fish being used. In some cases the use of "Drikold" resulted in an increased price being obtained compared with the normal price fetched by the same commodity when transported in the ordinary way. One great advantage of carbon dioxide as a refrigerant is that copper and its alloys can be used in the construction of the refrigerator, whereas ammonia, owing to its corrosive properties, would be out of the question.

The Iron and Steel Institute and the Institute of Metals.

A JOINT Autumn Meeting of the Iron and Steel Institute and the Institute of Metals will be held in London from Monday, September 12th, to Thursday, September 15th, 1932. The provisional programme is as follows :—

On Monday, September 12th, the secretaries' office will be opened at 3 p.m. at the Institution of Mechanical Engineers, Storey's-gate, St. James's Park, Westminster, S.W. 1, for registration of members and distribution of programmes, tickets, badges, &c. At 8 p.m. the Annual Autumn Lecture of the Institute of Metals will be read at the Institution of Mechanical Engineers by Dr. H. J. Gough on "Corrosion Fatigue in Metals." Dr. Gough will deal with both steel and non-ferrous metals.

On Tuesday, September 13th, a joint morning session will be held at the Institution of Civil Engineers, Great George-street, Westminster, S.W. 1, at 10 a.m. The following papers will be presented :—By the Iron and Steel Institute : "Metallurgical Problems Connected with Internal Combustion Engine Valves," by J. R. Handforth ; "Nickel-Chromium-Silicon Cast Irons," by A. L. Norbury and E. Morgan. By the Institute of Metals : "Modern Works Plant and Equipment for the Hot Working of Nickel and Nickel Alloys," by W. R. Barclay, G. A. V. Russell, and H. Williamson ; "Mould Materials for Non-ferrous Strip Ingot Castings," by G. L. Bailey and "Some Reactions Occurring in 'Hot Dipping' Processes," by E. J. Daniels. The session will conclude at 1 p.m. In the afternoon separate afternoon sessions will be held. The Iron and Steel Institute will meet at the Institution of Civil Engineers at 2.30 p.m., when the following papers will be presented :—"Equilibrium of Certain Non-metallic Systems—Part III.: Equilibrium of the Systems $MnSiO_3$–Fe_2SiO_4 and FeS–Fe_2SiO_4," by J. H. Andrew and W. R. Maddocks ; "Time-Potential Curves on Iron and Steel and their Significance," by T. P. Hoar and U. R. Evans ; "Effect of Hydrogen Sulphide on the Corrosion of Iron by Salt Solutions," by S. C. Britton, T. P. Hoar and U. R. Evans ; and "Scale Removal by Acid Pickling," by A. B. Winterbottom and J. P. Reed.

The Institute of Metals will meet at the Institution of Mechanical Engineers at 2.30 p.m., when the following papers will be presented :—"The Effect of Pressure on the Liberation of Gases from Metals (with special reference to Silver and Oxygen)," by N. P. Allen ; "On the Removal of Gases from Aluminium Alloys by Mixtures of Nitrogen and Volatile Chlorides," by J. D. Grogan and T. H. Schofield ; "Researches on Beryllium," by H. A. Sloman ; "Some Attempts at Making Beryllium-Magnesium Alloys," by R. J. M. Payne and J. L. Haughton ; "The Constitution of the Lead-Tin Alloys," by D. Stockdale ; "The Effect of Different Elements on the Annealing and Grain Growth Characteristics of Alpha Brass," by M. Cook and H. J. Miller ; and "Liquation or 'Inverse Segregation' in the Silver-Copper Alloys," by J. H. Watson.

In the evening at 8 p.m. a Conversazione will be held at the Science Museum, Exhibition-road, South Kensington, when the guests will be received by the Presidents, Colonel Sir Charles Wright, Bt., K.B.C., C.B., and Sir Henry Fowler, K.B.E., LL.D., D.Sc.

On Wednesday, September 14th, separate sessions will start at 10 a.m. The Iron and Steel Institute will meet at the Institution of Civil Engineers and the Institute of Metals at the Institution of Mechanical Engineers. The following papers will be presented :—Iron and Steel Institute : "Generation of Steam from Blast-furnace Gas," by A. F. Webber ; "Lightweight High-pressure Gas Cylinders," by F. S. Marsh ; "Fatigue Resistance of Unmachined Forged Steels," by G. A. Hankins and M. L. Becker ; and "Endurance Limit of a 0·33 per cent. Carbon Steel at Elevated Temperatures," by J. W. Cuthbertson. Institute of Metals : "Mechanical Properties of Nickel Wire," by C. E. Ransley and C. J. Smithells ; "Atmospheric Acton as a Factor in the Fatigue of Metals," by Dr. H. J. Gough and D. G. Sopwith ; "The Distortion of Wires on Passing Through a Draw Plate," by G. I. Taylor and H. Quinney ; "A Modified Impingement Corrosion Apparatus," by H. W. Brownsdon and L. C. Bannister ; "The Open-air Corrosion of Copper—Part III.: Artificial Production of Green Patina," by W. H. J. Vernon ; "Two Years' Corrosion Tests with Duralplat in the North Sea," by K. L. Meissner ; and "The Properties of Commercial Varieties of Copper at High Temperatures," by T. G. Bamford.

Other papers will be taken as read and correspondence is invited.

On Wednesday afternoon the following visits have been arranged :—National Physical Laboratory (trains leave Waterloo at 2.10 and 2.13 p.m. for Teddington) ; General Electric Company's research laboratories, lamp and glass works, Wembley (train leaves Euston at 2 p.m. for North Wembley) ; Acton Refinery, the Mond Nickel Company, Ltd. The party is limited to forty. Omnibus will leave Caxton-street, Westminster at 2.15 p.m.

On Thursday, September 15th, an all-day excursion has been arranged to the Dagenham works of the Ford Motor Company, Ltd. Steamer will leave Westminster Bridge pier at 11 a.m. Those not wishing to visit the Ford works may proceed to Greenwich Hospital. The steamer leaves Dagenham at 5 p.m., and arrives at Westminster Bridge pier about 7 p.m.

INDUSTRIAL DEVELOPMENT EXHIBITION.

AN Exhibition of Industrial Development for the Dartford division of Kent was held at Bexley from July 18th to 23rd. The Exhibition was organised in order to attract new industries to a locality that is claimed to have considerable facilities for manufacturing purposes, such as the proximity to the river and the Port of London, and rapid road and rail transport. Amongst the chief exhibitors may be mentioned Callender's Cable and Construction Company, Ltd., whose business is too well known to call for comment, and the Atlas Preservative Company, Ltd., whose cleansers and preservative paints, especially that used against the ravages of the white ant, attracted considerable interest. Cement, which is manufactured in very large quantities in Kent, was represented by the Cement Marketing Company, Ltd., which claims that the introduction of "Snowcrete," the British white Portland cement, marks a new era in the colour treatment of concrete. The well-known engineering firm of Fraser and Chalmers had a stand showing some of its mining machinery, such as conveying and screening plant, power plant, and rolling mill installations, all manufactured at Erith. J. and E. Hall had exhibits covering many branches of engineering. Founded in 1785, the firm's activities consisted at first chiefly of millwright work for paper mills. Early in the nineteenth century beam engines were built, and later on attention was turned to refrigerating plant. To-day the firm is devoting much attention to the construction of escalators. Two other interesting stands were those of Thomas Jackson and Sons, sheet metal workers and engineers, and Paper Makers Chemicals, Ltd. It was obviously impossible to give a representative exhibition of the products of Vickers-Armstrongs, Ltd., including as they do units of the British Navy and merchant ships, but a good selection of light machinery manufactured at the firm's southern works was shown.

BRITISH STANDARDS INSTITUTION.

All British Standard Specifications can be obtained from the Publications Department of the Institution at 28, Victoria-street, London, S.W. 1. The price of each specification is 2s. 2d. post free, unless otherwise stated.

"A GUIDE TO AERODROME LIGHTING."

No. C.C. 7631. In few cases, if ever, is standardisation of more importance to safety than in connection with the light signals and lighting appliances used for the guidance of night air traffic. The standardisation of marine lights was effected many years ago, but night flying is relatively so new that the new guide to the lighting of aerodromes is the first official pronouncement which gives in a concise, readable form, detailed information on the characteristics and methods of use of the lights required on an aerodrome. In the new guide the functions of the various lights are first explained and then follows a description of the manner in which a pilot will use their indications as he approaches and lands at the aerodrome. After this introduction, definitions are given, together with brief specifications of the five types of lighting equipment which are recommended as the minimum requirements of a properly equipped aerodrome. The following apparatus is specified : —A location beacon, boundary lights, illuminated wind indicator, obstruction lights and landing flood-light. As a conclusion, extracts from appropriate international regulations are reproduced. The guide has been prepared more particularly for local aerodrome owners, aircraft operators, municipal authorities and pilots, but although reports and technical papers dealing with this subject have been available for the expert, this new summarised guide should be of considerable value to expert and non-expert alike.

AN AMERICAN STEAM POWER STATION.

To supplement its three hydro-electric power stations the City of Tacoma, U.S.A., has built a steam power station of 25,000 kilowatts capacity, with provision for an ultimate increase to 100,000 kilowatts. It is situated on a site of 20 acres along a channel connecting with the harbour, so that it will have an unlimited supply of sea water at temperatures below 55 deg. Fah. for cooling purposes. The present building is 92ft. by 163ft. in plan, and is of concrete and brick construction, except for one side wall of steel plate to provide for future extension. Coal may be brought by ship or rail, and there is storage capacity for 8000 tons, held in reserve. The handling of this coal for storage or for use is done by locomotive cranes. Current is delivered directly to the city distribution system at 13,800 volts, three-phase, 60 cycles. The turbo-generator unit, of 25,000 kW, has a fourteen-stage turbine, operating at 385 lb. steam pressure and 725 deg. Fah., with a speed of 1800 revolutions. It is bled at the third, seventh, and eleventh stages for heating feed water. The single-pass condenser has 18,000 square feet of condensing surface, exclusive of the after-cooler. Its performance is based on 29in. vacuum at 25,000-kW load, using 34,000 gallons per minute of cooling water at 59 deg. Two boilers of the bent tube and drum type generate each 150,000 lb. of steam per hour at 420 lb. pressure and 750 deg. temperature. For each boiler there are two coal pulverisers supplying two burners of the flare type. The ash is sluiced from collecting hoppers to tunnels and thence by water jets to an ashpit from which it is pumped to a waste pile. Coal is fed by gravity to automatic weighing machines, from which it flows to the pulverisers. The burners can be adapted to the use of oil or natural gas as fuel.

ACCORDING to the *Far Eastern Review*, the Angara River system of Siberia is capable of developing 13 million kilowatts of hydro-electric energy. The combined capacity of the industries included in the projects of the Angara system is expected to reach the following totals by 1942 :—Electric power, 6 million kilowatts ; steel and ferro-alloys, 7 million metric tons per year ; aluminium, 400,000 tons ; copper, 100,000 tons ; zinc, 100,000 tons ; lead, 60,000 tons ; artificial rubber, 100,000 tons ; liquid coal fuel, 2 million tons ; nitrogen fertilisers, 100,000 tons ; calcium carbide, 10,000 tons ; sawn lumber, 14 million tons ; paper, 2 million tons ; artificial fibre, 30,000 tons ; and cement, 1 million tons annually.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Approaching Holidays.

THERE has been little new business about in iron and steel circles in the Midlands and Staffordshire this week, consumers being content to leave the placing of orders until after the August holiday break. Works in this area have for the most part very little reserve of work, and the vacation is likely to be of an extended character in a large number of cases. Indeed, a full week's idleness will probably be the rule and not the exception. This week activity has improved somewhat, production in the manufacturing branches having, where necessary, been speeded up in order to clear the workshops before the holidays. The weekly gathering of ironmasters on 'Change in Birmingham was small, and there were no developments of note. Values of material appear to be exactly as they were a week ago, and sellers' quotations are unchanged. Producers of iron and steel are hoping for a favourable flow of trade after the holiday break, while consumers trust that there will be a collection of orders on which to make a resumption. All look for a release of demand, at present suppressed, in the early autumn.

Hopeful Augury.

The news from Ottawa that the representatives of the United Kingdom and the Canadian iron and steel industries have arrived at an agreement which would be of great benefit to this country if it is approved by the Imperial Conference, has created considerable interest in the Black Country to which the prosperity of the iron and steel trade is of such vital importance. This district, with its iron and steel mills and manufactures of iron and steel, would obviously benefit enormously if, as is hoped and expected from the agreement, the Canadian manufacturers are ready to recommend their Government to extend further tariff preference to British iron and steel. The report is very welcome, and industrialists hope for the fulfilment of its promises.

New Birmingham Factory.

A large factory is now in course of erection on the Tyburn-road, Birmingham, for the manufacture of motor tire valves—articles which have hitherto been imported in large quantities from Switzerland and America. This development will introduce an important new industry to the district, and labour to the extent of some 300 hands is likely to be engaged. Not only so, but it is authoritatively stated that the whole of the raw materials required in connection with the Birmingham factory will be purchased in Birmingham, and will thus create further employment in the trades concerned. The factory is being constructed for the firm of Dubied et Cie. S.A., whose headquarters are at Neuchatel, Switzerland. The company already has extensive factories at Couvet, Switzerland ; Pontarlier, France ; and Milan, Italy. Its extensive British market is to be served entirely from the Birmingham factory, which has now reached an advanced stage of construction. Production is expected to begin at an early date.

Work for the Midlands.

Midland firms have recently secured acceptable contracts which will help to tide them over the present dull manufacuring period. W. G. Bagnall, Ltd., of Stafford, has received an order for ten locomotive boilers from the Eastern Bengal State Railway, and Braithwaite and Co. (Engineers), Ltd., of West Bromwich and Westminster, are to supply and erect approximately 260 tons of steel structural work required in connection with the Southern Railway Company's electrification scheme. Messrs. Braithwaite have also recently secured an order for 220 tons of steel work and corrugated roofing, &c., required by the Colombian National Railway. Charles Richards and Sons, Ltd., of Darlaston, and Thomas Wm. Lench, Ltd., of Blackheath, have secured orders from the Egyptian State Railways Administration.

New Waterworks.

The Ministry of Health has approved the Shrewsbury Corporation's new scheme for supplying the town with water from the river Severn, at an estimated cost of £102,253, and contracts for the work will be completed in a few days. The new works will be constructed in the neighbourhood of Shelton, 2 miles from the centre of the town. The supply is at present received from the river at Coton Hill, and through an iron reservoir, some 40ft. or 50ft. in height, erected in the centre of the town, which has been in use for the past seventy years and has been declared unsafe.

Pig Iron.

While the immediate position at the blast-furnaces in Derbyshire, Northamptonshire, and Staffordshire is unsatisfactory, business being almost at a standstill owing to the holidays, the prospects for the industry are improving. Foundries in this area which are concerned with the domestic heating trade are now preparing for their busy season, and as soon as work is recommenced the placing of orders for raw material should be one of the first events. Midland smelters unfortunately, cannot look for any such accession of demand from the heavy engineering foundries, but they sincerely trust that there will be more business from this quarter than has been the case of late. In any event, there are such stocks of material available that output of pig iron from Midland furnaces is not likely to exceed the present restricted rate for some time to come. Blast-furnacemen, however, await the customary "spurt" in trade which autumn brings, being content for the present to keep stocks from accumulating further. Selling prices of Midland brands of iron are upheld at the basis fixed by the Central Pig Iron Producers'

Association, namely, Derbyshire No. 3 foundry, £3 6s.; forge, £3 1s.; Northamptonshire No. 3 foundry, £3 2s. 6d., forge, £2 17s. 6d.; North Staffordshire No. 3 foundry; £3 6s.; forge, £3 1s.—all per ton delivered to stations in the Black Country.

Steel.

Heavy steel is selling very slowly, and all the works are in need of specifications. Orders from structural engineers and shipbuilders continue difficult to secure, and special steels for the motor trade are not as much in demand as they were. The steel mills hope, when business is resumed, for better support from the engineering branches than they have been receiving of late. Many of the heavy steel-consuming works have closed down until Monday week. Finished steel quotations are unchanged, angles being £8 7s. 6d., less 15s. rebate to participants in the rebates scheme; tees, £9 7s. 6d., less 15s.; joists, £8 15s., less 22s. 6d.; ship, bridge, and tank plates, £8 17s. 6d., less 15s. Boiler plates are in only moderate request, and values range from £8 7s. 6d. to £8 10s. per ton. Producers of semis report poor business this week. There has been no real test of values. Small steel bars re-rolled from Continental billets are quoted by Staffordshire re-rollers at £6 7s. 6d. upwards. All-British bars are £7 upwards. Mild steel billets range from £4 17s. 6d. to £5 7s. 6d., and sheet bars cost £4 15s. upwards. Staffordshire hoops are £9 10s. Continental prices have been slightly higher, but are still substantially below the level of locally made steel. The strike on the Continent did not affect this market to any appreciable extent, mainly because users of foreign bars and billets are well stocked, and had no need of fresh supplies.

Manufactured Iron.

Staffordshire ironworks are to have a long holiday, there being no necessity for an early restart after the annual vacation. The volume of work is much as in recent weeks, and ironmasters will be pleased if orders collect while the works are idle. This remark applies particularly to the Crown bar branch, in which production has been very light of late. In the best bar branch producers make a moderate output and dispose of it at the full price of £12 per ton. Makers of merchant bars experience great difficulty in selling against ironmasters from other areas, and the "cutting" in prices which results from this competition has brought selling rates to an unremunerative level in this area. A number of Staffordshire ironmasters refuse to negotiate for business at the current market minimum of £9. They ask substantially more. Nut and bolt and fencing bars are disposed of in small quantities at prices ranging from £7 15s. to £8. Wrought iron gas tube strip is held for £10 10s. Belgian No. 3 iron for the bolt and nut industry of the Black Country is on offer at £5 17s. 6d.

Galvanised Sheets.

Galvanised sheets are weak at £9 5s. for 24 gauge corrugateds and the mills are working below capacity, very largely because of the scarcity of orders from abroad. Millowners report that many of their overseas markets are inactive owing to financial stringency. More trade could be done, but for financial difficulties. Demand from home sources is hardly so good as it was recently, but is expected to revive after the August holidays.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Industrial Liverpool.

AN industrial survey of Liverpool and district similar to the one carried out in respect of Manchester by the Economics Department at Manchester University, has been prepared for the Board of Trade by the economics staff of Liverpool University, and the results have been published during the past week. The point is emphasised that the prosperity of Liverpool is dependent more upon industrial conditions in the North of England generally than upon the industries of the Merseyside area itself. Taken as a group, unemployment in the metal, engineering, and electrical industries of Liverpool has grown from 17·4 per cent. in 1930 to 27·8 per cent. last year, and it is stated in the survey that these industries will closely reflect any improvement in the general trade situation, and will, moreover, probably be one of the major industrial groups during the prospective upswing of the trade cycle to absorb at least its own existing unemployed. Analysing the probable effects of a general tariff on the industries of the Liverpool district, the electrical and metal industries are placed among those which, it is believed, will gain, the engineering industries rank among those which may be injured because of increased production costs, whilst the shipbuilding industry is placed among those which may be harmfully affected through a reduction in international trade.

The Broughton Copper Company, Ltd.

The scheme for the reduction and reorganisation of the share capital of the Broughton Copper Company, Ltd., Manchester, was approved at extraordinary general meetings of shareholders held in Manchester last Friday. At the preceding ordinary annual general meeting Mr. Leonard Sumner, chairman of the board of directors, stated that as the bulk of the company's trade was connected with the shipping and shipbuilding industries, the locomotive building industry, the home railways, and textile industry, it was not surprising, having regard to the parlous condition of these industries, that the past year had proved even more unsatisfactory from the point of view of the company than was the previous year. Mr. Sumner referred to the efforts that are continually being made to find new outlets for the company's manufactures and to develop new products, and he acknowledged the great help the firm was receiving from the suggestions made by its metallurgical adviser, Dr. Rosenhain. Mr. Sumner, who has resigned from the chairmanship of the company, whilst remaining a director, has been succeeded as chairman by Vice-Admiral Sir Robert Dixon.

Closing a Mine.

Manchester Collieries, Ltd., have decided to close down its Agecroft pit at the end of this week, and notices to this effect were posted at the mine last Friday. About 800 workpeople will be affected. It is estimated that the supply of available coal in the pit is equivalent to about fifty years' production. Working costs, however, have become too heavy to permit of continued operations, although it is proposed to keep the mine in working order with a view to a possible reopening in the event of an improvement in trade conditions.

Industrial Results.

It is announced that Edward Wood and Co., Ltd., of the Ocean Ironworks, Manchester, sustained a loss for the year to May 31st of £13,154, compared with one of £7158 in the previous year. The directors state that the depressed conditions and consequent curtailment of building development resulted in a lower turnover than in the previous year. Fodens, Ltd., Sandbach, Cheshire, steam wagon makers, report a loss for the twelve months ending June 30th of £49,404, against £15,271 for the previous year. Mather and Platt, Ltd., engineers, Newton Heath, Manchester, have declared an interim dividend on the ordinary shares of 2½ per cent., which is the same as in the previous year.

Non-ferrous Metals.

Continued weakness in the copper section of the non-ferrous metals market has had some reaction at times on the other metals, although there has since been a recovery in both lead and spelter. The trade demand for copper has been of limited extent, and in the absence of any improvement in the statistical position prices during the week have touched new low levels, the movement being helped by rather heavy selling by speculative interests. The fall on balance, however, has amounted to less than 10s. per ton in the case of standard brands and has not been so severe as in the previous week. After its recent upward movement tin has reacted to the extent of nearly £1 per ton, a further slight reduction in warehouse stocks of the metal in this country being offset in its market effects by the unsatisfactory position of copper. Buying interest in lead has only been on a moderate scale, but there was a recovery in the late dealings after early weakness, and on balance quotations are a few shillings higher. This has also been the experience in respect of spelter, closing values being equivalent to a recovery of the slight loss in the preceding week.

Iron and Steel.

Business in the iron and steel markets this week has continued quiet, a condition which continues to be accentuated by the holiday season. A few fresh contracts extending over several months have been reported in the foundry iron section, but only the few better-placed users are disposed to cover more than early needs. Offers of pig iron for delivery in the Manchester district are fully maintained, however, at 67s. per ton for Staffordshire, Derbyshire, and North-East Coast brands, 65s. 6d. for Northamptonshire, 62s. 6d. for Derbyshire forge, about 84s. 6d. for Scottish No. 3, and 81s. for West Coast hematite, with Indian iron quoted for delivery to users in the district at from 67s. to 77s. per ton. The heavy supplies of scrap continue to exercise a restrictive influence on the demand for pig iron here. The bar iron trade is relatively slow, but at £10 5s. per ton for Lancashire best bars and £9 15s. for Crown bars values are steady. There has been only a very moderate inquiry about for both heavy steels and special alloy varieties. Quotations for boiler plates and small re-rolled bars are not strong, but in all other respects the market for home-produced steels is well held at late rates.

BARROW-IN-FURNESS.

Hematite.

The general tone in the hematite pig iron market is quiet and deliveries are not so heavy, probably owing to holiday stoppages. The production of iron at Barrow, which was going mostly into the steel department, has been temporarily stopped for the holidays to allow of overhaul and repairs. Makers are not experiencing much forward booking at present, but there is a general feeling that a better state of things will come, and some are pinning their hopes on the possible agreement with Canada. There are still plenty of stocks at the various works. Continental and American business is practically at a standstill. The iron ore trade is quieter, and apart from a reduced local demand the outside inquiries are thin. The steel market is very quiet and few orders are obtainable.

Shipbuilding.

Hopes are being expressed here that about the middle of next month the Admiralty will be placing contracts with outside yards and that Barrow will get a share of them. It is practically a certainty that this district will be entrusted with the manufacture of machinery and gun mountings, but many would like to see an order for a cruiser. If Barrow is not awarded a contract for the building of a cruiser it will probably be given one for submarines and a destroyer or two.

SHEFFIELD.

(From our own Correspondent.)

The General Position.

WITH the approach of the holiday dull conditions of trade have been inevitable. At the same time there are hopes of the position improving, and in some cases the holiday stoppages arranged is not so long as in previous years. Although there has been a shrinkage in the number of orders, as is expected at this, the quietest, time of the year, several departments of the steel and allied industries are fairly well employed. An interesting feature of the ferro-alloy market has been a reduction in the price of tungsten, but this concession, although substantial, does not appear to have stimulated the interest of users, for there has been no noticeable increase of sales. There is a fairly good demand for low carbon ferro-chromes for making stainless steels, but the ferro-alloy market generally is very quiet.

Government Contracts.

Some valuable new Government contracts have been obtained by local firms. Points and crossings are to be supplied to the Admiralty (Civil Engineer-in-Chief's Department) by T. W. Ward, Ltd., Sheffield, and to the War Office carbon tool steel is to be supplied by Jonas and Colver (Novo), Ltd., Sheffield, and round steel by S. Fox and Co., Ltd., Stocksbridge, near Sheffield. A contract for locomotive tires has been obtained from the Crown Agents for the Colonies by J. Baker and Bessemer, Ltd., Rotherham. It is understood that tenders for the ships of the 1931 naval programme are now being considered by the Admiralty, and that orders for twenty-two vessels will be placed shortly. Six vessels, it is stated, will be built in the Royal Dockyards and the remainder will be constructed by contract. The Clyde and the Tyne hope to secure the greater share of the work, and Sheffield expects to benefit very considerably. Local firms will probably make tools and machinery for the shipyards as well as armour plate, shafts, and guns for the ships.

Foundry Modernisation.

An important trading agreement has been made between Davy Brothers, Ltd., the well-known Sheffield firm, and August's, Ltd., of Halifax. The Halifax firm is to undertake the sale and installation and Davy Brothers the manufacture of plant and equipment for the modernisation of foundries. It is pointed out that the actual disposition of the equipment in a foundry is of as great importance as the selection of the right type of equipment. August's, Ltd., has for some years specialised in the lay-out and design of foundry equipment. In recent years the greater portion of the foundry equipment required by home industries has been imported from abroad. It is believed that any foundry reorganisation in this country could be advantageously carried out by the joint organisation of the Sheffield and Halifax firms in place of being left, as hitherto, largely in the hands of foreign designers and engineers. The trading agreement, it is expected, will bring to Davy Brothers permanent occupation outside the firm's main products of plant and equipment for the heavy iron and steel industries.

Files, Hacksaws, and Tools.

The file factory of the English Steel Corporation, at Hillsborough, Sheffield, is fairly well employed and has been working overtime. Some other file manufacturers complain of varying conditions, but several of them have orders which will last for a few weeks. There is a good demand for hacksaws and some of the better classes of tools, whilst firms specialising in the cheaper articles are doing fairly well. For more than fourteen years Arthur Balfour and Co., Ltd., Sheffield, have specialised in the manufacture in bulk of hacksaw blades, and the growth of this part of the business resulted in a decision to equip a separate building for the purpose, with four times the original floor space. Efficiency has been greatly improved and a very fine hacksaw manufacturing factory, equipped in modern style for easy working and large output has resulted.

Cutlery Marking.

The report of the Standing Committee set up under the Merchandise Marks Act, 1926, to report on spoons, forks, knives, &c., recommends that certain articles of a type used for domestic purposes shall bear an indication of origin on importation and on sale or exposure for sale, both wholesale and retail. The decision of the Standing Committee is welcomed by Sheffield cutlery firms, which for a long time have been agitating for the marking of imported goods. The application for the marking of the goods referred to was made in May last and was presented to the Board of Trade by Mr. R. H. C. Ward, secretary of the Sheffield branch of the Manufacturers' Union. It is regretted that in the case of articles other than cutlery the alternative was offered of the use of labels. A permanent marking should have been insisted upon, it is contended. There is hope that the order will stem the flow of foreign articles into this country.

Bid for Trade.

Two Yorkshire towns, Rotherham and Wakefield, have taken stands at the Canadian National Exhibition in Toronto. The towns' advantages for the establishment of industries will be displayed. Rotherham is offering special facilities to automobile companies and to firms interested in wide strip rolling mills and engineering plants. Wakefield's exhibits will consist principally of textiles, but there will also be examples of its engineering industries, whilst Rotherham will have an impressive group of exhibits mainly the products of its heavy industries.

Sewage Disposal Works.

The Leeds Corporation's sewage disposal works at Knostrop are now nearing completion. Last year 9000 million gallons of sewage were dealt with, 1100 tons of screenings were taken from the sewage by mechanical screens, and 3700 tons of grit were taken out of the grit pits. In the tanks 131,000 tons of liquid sludge were deposited and there were 35,000 tons of hard cake. The work already accomplished has had a marked effect on the purification of the river Aire.

NORTH OF ENGLAND.

(From our own Correspondent.)

Work for Shipyards.

NORTH-EAST COAST shipyards are receiving a fair amount of repair and conversion work. Swan, Hunter and Wigham Richardsons Ltd., Wallsend, have booked contracts for improvements to vessels, which it is expected will keep a considerable number of men employed for about three months. One contract is for insulating the Shaw Savill and Albion steamer "Herminus," which has been started, and similar work on a sister ship the "Pakeha," which arrived early this week. Another vessel to be dealt with is the "Apsley Hall," on which improvements are to be effected, including additional steel work. Messrs. Swan, Hunter have shown commendable enterprise in their search for new work in order to keep their apprentices and as many as their staff as possible employed. They have built one new ship as a speculation, the work being done by apprentices. The firm is now making refrigerators which can be used in houses, and also ladders, garden seats, furniture, &c. This work is being done in the joiners' department. Sir W. G. Armstrong, Whitworth and Co., Ltd., has secured a contract for machinery alterations and conversion to the Bauer-Wach system of two Hall Line vessels of the Ellerman fleet. One of the ships is the "City of Khios," which is at present at the yard of the Middle Docks and Engineering Company, Ltd., South Shields.

Cleveland Iron Trade.

The outlook for the near future of the Cleveland pig iron trade is causing some uneasiness, as the volume of new business passing is insufficient to maintain works in activity as orders on hand run out. The quietest period of the year from a trading point of view has, of course, been entered upon, but business is much slacker than anticipated. Sales to Scotland are restricted by the holidays, and local consumers are buying very sparingly, owing to limited needs and the hope which is still cherished of a fall in prices. Quotations, however, are maintained in spite of a recent increase in makers' stocks. No. 1 Cleveland foundry iron is 61s.; No. 3 G.M.B., 58s. 6d.; No. 4 foundry, 57s. 6d.; and No. 4 forge, 57s.

Hematite Pig Iron.

The East Coast hematite pig iron trade is dull, and the keen competition is forcing down the price. Mixed numbers are now quoted at 61s., and even less has been accepted. It is reported that 2000 tons have been sold for export for delivery over the next two months, but it is understood that a very low figure has been accepted. Owing to the accumulation of stocks, one furnace is to be closed and another damped down at the Normanby Ironworks.

Ironmaking Materials.

Business in the foreign ore trade is virtually at a standstill, and it is difficult to ascertain terms on which new contracts might be made. Until there is an improvement in the pig iron industry, the demand for blast-furnace coke will continue on small lines. The desired expansion has not yet set in, but there are hopes of better trade in the autumn months. Good medium qualities are freely offered at 15s. 6d. delivered at the works.

Manufactured Iron and Steel.

There are no new features in the manufactured iron and steel trade. Specifications are scarce, and works are badly in need of prompt business, though optimism prevails regarding the autumn outlook. Departments turning out constructional steel have a good deal of work on hand, but in nearly all other branches order books are light. Prices are unchanged.

The Coal Trade.

The Northern coal trade position has few bright spots at the moment, and a good many of the collieries are not hopeful of much change until next month is well advanced. Then autumn consumption will show itself, and with it will come more home trade. While this business will be welcome, it is only seasonal, and it will not make much difference to the demand for awhile. With the possible exception of some brands of Northumberland large coal, there are few foreign inquiries for any grade of coal. There are no signs of any modification in foreign restrictions on coal imports, and bunkers are affected by the huge amount of idle tonnage. The greatest ingenuity has to be exercised in order to accommodate the increasing number of vessels on the laid-up list. Steamers are coming home from numerous quarters of the globe, and it is a problem to find berths for them. The absence of demand gives a weak tone to the steam coal section, and although fitters have curtailed the output as far as possible, there are still ample stocks on offer. Best screened are easy at the fixed minimum of 13s. 6d. and prime Wear at 15s. to 15s 1¼d. Tyne primes are offered readily at 12s. 9d., and secondary Northumberland at 12s. to 12s. 3d. For small coal the demand is sufficient to absorb the current moderate output, but accumulated stocks are untouched. Northumberland small is worth 8s. 6d., Tyne best 9s., and other qualities 8s. Only the schedule prices prevent further falls in gas coal values. Stocks of every description are ample, but there is no pressure from buyers, and under old contracts requirements are at a minimum. Best Durham gas coals are weak at 14s. 6d., secondary at 13s. to 13s. 3d., and prime Wear qualities 15s. to 15s. 1¼d. Bunker coals are weak in tone at 13s. 6d. to 13s. 9d. for best and 13s. for good ordinary. The demand for gas coke is slow. Best is at 17s. 3d., and other makes at 17s. Patent oven coke remains quiet at 14s., and superior qualities are at 15s. to 16s.

SCOTLAND.

(From our own Correspondent.)

Extended Holidays.

IN the ordinary course of events the annual holidays would have ended last Saturday, but this year a general resumption will not be made before August 1st. The collieries in Lanarkshire and Fifeshire have made a quiet restart, but steel and ironworks are still on holiday.

More Hopeful Outlook.

Though actual business in steel and iron has not shown any material increase, the inquiry has improved a little, and producers are hopeful that trade arrangements of mutual benefit will be the outcome of the deliberations at Ottawa. This season already there have been indications of greater interest on the part of Canadian buyers, and it is confidently anticipated that the movement will be strengthened and extended to other countries within the Empire. The possibility of private and Admiralty work for the Clyde also helps to improve the outlook for the autumn and winter months.

Free State Tariffs.

It is not anticipated that the Free State tariffs will make much difference to the amount of trade in steel, iron, and coal from this district. For a considerable period, steel and iron from this country have only been used where specially specified, the market otherwise being full of cheap Continental material. So far as the coal trade is concerned, little effect is expected. A fair business is done from Ayrshire ports to the Free State, and the duty immediately imposed will not, it is said, make the local fuel non-competitive in comparison with Continental coal.

Pig Iron.

The number of furnaces in operation in Scotland has been reduced to three, of which one is producing foundry and two hematite iron. Last week the Shotts Iron Company, Ltd., damped down its new furnace for an indefinite period, and the two furnaces which have been in operation at the Gartsherrie Works of William Baird and Co., Ltd., have been blown out. Supplies of pig iron are ample, and although Continental material has been more or less eliminated, local producers have still to face keen competition from Indian iron. Occasional lots also arrive from England.

Coal.

The coal market has been comparatively quiet, and the volume of business was not sufficient to test the markets. Shipments of fuel from Ayrshire ports were considerably larger than usual, in view of the coming tariff, and in all probability the amount would have been larger if tonnage had been available. Otherwise, the feature of the market is the continual firmness of washed nuts, especially trebles. Large coals as a rule are in good supply for prompt delivery. The general inquiry is restricted, home requirements being under normal and the shipping demand mostly of a small coastwise description. Aggregate shipments for the week amounted to 114,494 tons, compared with 219,701 tons in the preceding week, and 86,956 tons in the same week last year.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

The Coal Trade.

THE conditions prevailing in the steam coal industry give no indication of pre-holiday activity such as used to be witnessed in the old days. In the anthracite section it is true that work is on active lines, although perhaps not quite as brisk as might have been expected. Last week shipments of steam and anthracite coals from this area were disappointing, as the total for the six ports under the control of the Great Western Railway Company only came to 394,275 tons, as compared with 466,955 tons for the preceding week, although the quantity for the corresponding period of last year was only 390,636 tons. Some indication of the position at the docks at the end of last week can be seen from the fact that on Friday there were forty-five idle tips, while the week finished up with there being no less than sixty-two vacant loading berths, and there was not a single steamer waiting to load. Such conditions immediately before a holiday have scarcely been experienced before. This week commenced with thirty vacant loading berths and two steamers waiting, the latter being at Swansea. Business has been on a negligible scale for all directions, both as regards prompt and forward orders. Certainly July upholds its reputation for being one of the quietest months of the year.

South Wales and Coals for Ireland.

During the past week or so attention locally has been mainly centred on the position created by the Irish Free State Government's decision to impose a tariff on coals from this country to Ireland. The report current last week was that it was the intention of the Free State Government to place on British coals a tariff of 35 per cent. or an embargo. The official announcement of a tariff of 5s. per ton on coals is less than 35 per cent. based on the price of best Monmouthshire large coals, but in the case of lower-priced coals the percentage is over 35 per cent. In any case the tax of 5s. per ton amounts to practically an embargo, and the Monmouthshire area will be affected most. Unless there is a definite change in the situation it is to be feared that South Wales will lose the shipment of about 450,000 to 500,000 tons per annum, which in these times is a considerable item. Already negotiations have been proceeding for the shipment of German coals to the Free State. One steamer of 2500 tons has been chartered from Rotterdam to Cork at the rate of 5s. f.d., and one or two smaller steamers have also been fixed. The Free State Government's decision that the tax should operate as from the 26th inst. has caused complications for local shippers who had tonnage on charter and who in one or two cases had steamers loaded and ready to sail. As regards other commodities which the Free State has taxed, such as cement and iron and steel, this district is not affected to any very material extent.

Back-to-coal Movement.

As I mentioned last week, the decision of the Government not to set up a Commission as requested by the Back-to-coal Movement came as a severe blow to those interested. Representatives of this movement and Welsh members of Parliament met at Cardiff on Saturday last to consider the situation and decided to send an acknowledgment to Mr. Stanley Baldwin, expressing disappointment that the Government could not see its way to set up a Commission. It was also agreed to leave the matter in abeyance pending the result of the discussions with the Secretary of Mines, who has suggested that there should be a joint consideration by the Welsh members of Parliament of the information already available in the Government departments concerning coal utilisation and of what those departments are already doing to encourage the greater use of coal.

Workers' Holidays.

Pitwood workers at the various ports in this area will have three days' holiday next week, and so far as the coalfield is concerned the usual holidays, viz., three days, will operate, the night men going in on Wednesday night. In the case of the coal trimmers and tippers it was agreed last week that there should be no work on Monday or Tuesday next and that work should be resumed on normal lines on Wednesday. After that decision was come to the shippers at Swansea continued their efforts to secure that so far as Swansea was concerned the holidays should be confined to Monday and the matter was again considered at a meeting at Cardiff on Tuesday afternoon, when it was agreed that in order to deal with the pressure at Swansea there should be work by the coal trimmers and tippers on Tuesday, and two short shifts were arranged, running from 7 a.m. to 8 p.m.

Coal Loading Facilities.

It was announced at a meeting of the Swansea Chamber of Commerce last week that the G.W.R. Company contemplates the erection of an additional coal hoist at the King's Dock. It was further stated that the construction of the new tip was to be put in hand shortly and that an electrical arrangement was to be introduced on other tips which would considerably facilitate loading. Further developments are probable if the trade at Swansea docks continues to be as good as it is at present.

Miscellaneous Items.

Sir William J. Firth, chairman of Richard Thomas and Co., Ltd., was elected last week chairman of the Welsh Plate and Sheet Manufacturers' Association for the ensuing year. The Welsh tin-plate employers have agreed to continue the *ex gratia* bonus payment to the lower-paid men in the trade until November 5th. Operations have been resumed at the Yniscedwyn Tin-plate Works, Ystradgynlais, which have been idle for about two months. About 200 workers are affected. There has been no development so far in the situation concerning the South Wales Steel Works, Llanelly, owned by Richard Thomas and Co., where twenty-eight days' notices were issued by the company to the 600 men employed. Existing contracts are due to expire at the end of this week. Over 600 men ceased work at the end of last week at Llay Main Colliery, near Wrexham, owing to the pit's quota of output being limited to 17,500 tons per week, whereas it can raise 24,000 tons in five days. The management has decided temporarily to close one seam, in the South Brassey district. Gatewen Colliery, near Wrexham, is to be closed altogether at the end of this month, throwing about 300 men out of employment.

Current Business.

There has been no variation in the conditions governing the steam coal market. The inquiry from all quarters is extremely quiet, but dry coals are an exception to the easiness prevailing in the market. These qualities, especially sized coals, are scarce and firm. Patent fuel is well stemmed, but coke displays no improvement. Pitwood, owing to supplies not being brought forward so freely, is firmer, and prices range up to 22s. for French wood and 21s. 3d. for Portuguese wood.

CONTRACTS.

JOHN I. THORNYCROFT AND CO., Ltd., have received an order from the Cleveland Bridge and Engineering Company, Ltd., of Darlington, for a motor launch suitable for service on the Zambesi River in connection with the work now in progress for the construction of the new Zambesi Bridge. The Cleveland Company is already using two Thornycroft boats on the Zambesi. The new boat is to be 25ft. in length with a Thornycroft RA/4 30 B.H.P. engine. The hull will be of mahogany sheathed with copper.

BRADFORD CORPORATION SEWAGE WORKS.—In connection with our articles on the Bradford Corporation sewage plant in our issues of July 15th and 22nd, we learn that Israel Newton and Sons, Summerley Works, Idle, Bradford, designed, built, and maintained the shields for concreting the interior of the tunnel, illustrated in Fig. 2, page 55, and that these shields saved the Corporation several thousand pounds expenditure on timber.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
(1) Native	16/6 to 20/-
(1) Spanish	17/- to 22/6
N.E. COAST—	
Native	18/- to 21/-
Foreign (c.i.f.)	14/9

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	3 8 6	—
No. 1 Foundry	3 12 0	—
No. 3 Foundry	3 9 6	—
N.E. COAST—		
Hematite Mixed Nos.	3 1 0	3 1 0
No. 1	3 1 6	3 1 6
Cleveland—		
No. 1	3 1 0	3 1 0
Siliceous Iron	3 1 0	3 1 0
No. 3 G.M.B.	2 18 6	2 18 6
No. 4 Foundry	2 17 6	2 17 6
No. 4 Forge	2 17 0	2 17 0
Mottled	2 16 6	2 16 6
White	2 16 6	2 16 6
MIDLANDS—		
(c) Staffs.—	(*Delivered to Station*).	
All-mine (Cold Blast)	—	—
North Staffs. Forge	3 1 0	—
„ „ Foundry	3 6 0	—
(c) Northampton—		
Foundry No. 3	3 2 6	—
Forge	2 17 6	—
(c) Derbyshire—		
No. 3 Foundry	3 6 0	—
Forge	3 1 0	—
(3) Lincolnshire—		
No. 3 Foundry	—	—
No. 4 Forge	—	—
Basic	—	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	3 15 6 (*a*)	—
	4 0 6 (*b*)	—
	4 5 6 (*c*)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	9 15 0	9 5 0
Best	—	—
N.E. COAST—		
Iron Rivets	11 5 0	—
Common Bars	9 5 0	—
Best Bars	10 5 0	—
Double Best Bars	10 15 0	—
Treble Best Bars	11 5 0	—
LANCS.—		
Crown Bars	9 15 0	—
Best Bars	10 5 0	—
Hoops	12 0 0	—
S. YORKS.—		
Crown Bars	9 15 0	—
Best Bars	10 15 0	—
Hoops	12 0 0	—
MIDLANDS—		
Crown Bars	9 0 0 to 9 15 0	—
Marked Bars (Staffs.)	12 0 0	—
Nut and Bolt Bars	8 0 0 to 8 10 0	—
Gas Tube Strip	10 10 0	—

STEEL. (*d*)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates (Marine)	9 0 0	8 10 0
„ „ (Land)	—	—
Ship Plates, ½in. and up	8 15 0	7 15 0
Sections	8 7 6	7 7 6
Steel Sheets, ¼in.	7 15 0	7 15 0
Sheets (Gal. Cor. 24 B.G.)	11 0 0	10 5 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 15 0	7 15 0
Angles	8 7 6	7 7 6
Boiler Plates (Marine)	10 10 0	—
„ „ (Land)	10 0 0	—
Joists	8 15 0	7 7 6
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5s.
Hard Billets	7 2 6	—
Soft Billets	5 10 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 5 0	—
Light Rails	8 10 0 to 8 15 0	—
Billets	6 10 0 to 9 0 0	—
MANCHESTER—		
Bars (Round)	9 7 6	—
„ (Small Round)	6 15 0 to 7 0 0	—
Hoops (Baling)	10 0 0	9 15 0
„ (Soft Steel)	9 0 0	8 15 0
Plates	8 17 6 to 9 2 6	—
„ (Lancs. Boiler)	8 10 0 to 8 12 6	—
SHEFFIELD—		
Siemens Acid Billets	9 2 6 (basis)	—
Hard Basic	8 2 6 and 8 12 6	—
Intermediate Basic	6 12 6 and 7 2 6	—
Soft Basic	5 15 0	—
Hoops	9 10 0 to 9 15 0	—
Soft Wire Rods	7 10 0	—
MIDLANDS—		
Small Rolled Bars (all British)	7 5 0 to 7 15 0	—
Small Re-rolled Bars	6 7 6 to 6 10 0	—
Billets and Sheet Bars	4 17 6 to 5 7 6	—
Galv. Sheets, f.o.b. L'pool	9 5 0 to 9 7 6	—
(2) Staffordshire Hoops	9 10 0	—
(*d*) Angles	8 7 6	—
(*d*) Joists	8 15 0	—
(*d*) Tees	9 7 6	—
(*d*) Bridge and Tank Plates	8 17 6	—
Boiler Plates	8 7 6 to 8 10 0	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	f.o.b. 15/0 to 15/6
Block Tin (cash)	125 12 6
„ (three months)	127 5 0
Copper (cash)	25 0 0
„ (three months)	24 11 3
Spanish Lead (cash)	9 12 6
„ „ (three months)	9 15 0
Spelter (cash)	11 15 0
„ (three months)	11 16 3
MANCHESTER—	
Copper, Best Selected Ingots	29 0 0
„ Electrolytic	29 10 0
„ Strong Sheets	57 0 0
„ Tubes (Basis Price), lb.	0 0 9½
Brass Tubes (Basis Price), lb.	0 0 8½
„ Condenser, lb.	0 0 11
Lead, English	11 15 0
„ Foreign	10 5 0
Spelter	11 15 0
Aluminium (per ton—raw ingot)	£95

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	2/- per lb.	
Ferro Tungsten	1/9 per lb.	
Ferro Chrome, 4 p.c to 6 p.c. carbon	£25 0 0	8/-
„ „ 6 p.c. to 8 p.c.	£24 10 0	7/6
„ „ 8 p.c. to 10 p.c.	£23 15 0	7/-
„ „ Specially Refined		
„ „ Max. 2 p.c. carbon	£37 0 0	11/-
„ „ „ 1 p.c. carbon	£47 0 0	14/-
„ „ „ 0·70 p.c. carbon	£48 0 0	16/-
„ „ „ carbon free	1/1 per lb.	
Metallic Chromium	2/9 per lb.	
Ferro Manganese (per ton)	£11 0 0 for home	
„ „ „	£11 10 0 for export	
„ Silicon, 45 p.c. to 50 p.c.	£13 10 0 scale 5/- per unit	
„ „ 75 p.c.	£19 0 0 scale 6/- per unit	
„ Vanadium	12/6 per lb.	
„ Molybdenum	6/3 per lb.	
„ Titanium (carbon free)	9d. per lb.	
Nickel (per ton)	£250 to £255	
Ferro Cobalt	8/- per lb.	

FUELS.

SCOTLAND.

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	13/-
„ „ Ell	14/-
„ „ Splint	13/9 to 14/9
„ „ Trebles	12/6
„ „ Doubles	10/- to 10/6
„ „ Singles	9/3
AYRSHIRE—	
(f.o.b. Ports)—Steam	11/9
„ „ Jewel	16/6
„ „ Trebles	13/9
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	10/3 to 12/6
Screened Navigation	16/6
Trebles	13/6 to 15/6
Doubles	11/- to 11/6
Singles	9/6
LOTHIANS—	
(f.o.b. Leith)—Best Steam	11/- to 11/6
Secondary Steam	10/6
Trebles	14/- to 15/6
Doubles	11/6
Singles	8/9 to 9/-

(8) N.W. COAST— ENGLAND.

Steams	21/9
Household	32/6 to 51/8
Coke	19/- to 22/6
NORTHUMBERLAND—	
Best Steams	13/6
Second Steams	12/3 to 12/6
Steam Smalls	8/6
Unscreened	12/6 to 13/-
Household	27/- to 39/-
DURHAM—	
Best Gas	14/6
Second	13/3 to 13/6
Household	25/- to 37/-
Foundry Coke	24/-

SHEFFIELD—	Inland.	
Best Hand-picked Branch	25/- to 26/-	—
South Yorkshire Best	20/- to 21/-	—
Derbyshire Best House	20/- to 21/-	—
Derbyshire Best Brights	17,- to 18/-	—
Screened House Coal	15/- to 16/-	—
Kitchen Coal	14/- to 15/6	—
Best Screened Nuts	15/- to 16/-	—
Small Screened Nuts	13/6 to 15/6	—
Yorkshire Hards	16/- to 18/-	—
Derbyshire Hards	16/- to 18/-	—
Rough Slacks	8/6 to 9/6	—
Nutty Slacks	7/- to 8/6	—
Blast-furnace Coke (Inland)	10/- on rail at ovens	
Furnace and Foundry Coke (Export), f.o.b., 13/6 to 15/6		

CARDIFF— (9) SOUTH WALES.

Steam Coals:	
Best Smokeless Large	19/6 to 19/9
Second Smokeless Large	18/9 to 19/6
Best Dry Large	19/- to 19/6
Ordinary Dry Large	17/9 to 18/3
Best Black Vein Large	18/3 to 18/6
Western Valley Large	17/9 to 18/-
Best Eastern Valley Large	17/7½ to 17/9
Ordinary Eastern Valley Large	17/3 to 17/6
Best Steam Smalls	13/- to 13/6
Ordinary Smalls	11/- to 13/-
Washed Nuts	19/- to 25/-
No. 3 Rhondda Large	19/6 to 19/9
„ „ Smalls	15/- to 16/-
No. 2 „ Large	17/- to 17/3
„ „ Through	15/6 to 16/-
„ „ Smalls	14/- to 14/3
Foundry Coke (Export)	22/6 to 36/6
Furnace Coke (Export)	17/- to 18/-
Patent Fuel	20/-
Pitwood (ex ship)	21/- to 22/-
SWANSEA—	
Anthracite Coals:	
Best Big Vein Large	36/- to 38/6
Seconds	27/- to 32/6
Red Vein	22/6 to 27/6
Machine-made Cobbles	41/6 to 48/6
Nuts	40/- to 48/6
Beans	28/6 to 32/6
Peas	19/6 to 21/-
Breaker Duff	8/6 to 9/6
Rubbly Culm	11/- to 11/6
Steam Coals:	
Large	20/- to 20/6
Seconds	18/- to 20/-
Smalls	11/6 to 13/-
Cargo Through	16/- to 17/6

(1) Delivered. (2) Net Makers' Works. (3) f.o.b. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire. (6) Home Prices—All delivered Glasgow Station. (7) Export Prices—f.o.h Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (*a*) Delivered Glasgow (*b*) Delivered Sheffield. (*c*) Delivered Birmingham. (*d*) Rebate: Joists (minimum), 22/6: Ordinary Ship, Bridge, and Tank Plates and Sections, 15/- if home consumers confine purchases from associated British Steel Makers. (*e*) Delivered Black Country Stations.

French Engineering Notes.

(From our own Correspondent in Paris.)

Steel Trade Organisation.

STEEL producers have completed their organisation for limiting output to requirements and pooling orders, which will be distributed in ratio to the capacities of different firms, whereby the competitive element will be eliminated when fixing prices. Similar measures are being adopted by other groups, so that the situation of the iron and steel trades will be helpful to a recovery when the time comes. An arrangement has now been come to between the mill and forge owners' sales comptoir and the merchants' syndicate, particularly in the way of limiting stocks, so that merchants will be able to procure bars of special dimensions, for example, without being obliged to carry quantities on the chance of a sale. All this aims at reducing the overhead charges of merchants, encouraging co-operation amongst them and maintaining prices. Some such organisation is necessary in view of the unsatisfactory situation of many merchants who have been obliged to sacrifice stocks in these times of bad trade. There is, naturally, very little buying, especially now that the holiday season has accentuated the general dullness, but iron and steel prices are, nevertheless, upheld on the home market under cover of the import quotas. While constructive engineers have to pay fair prices for iron and steel, they are competing keenly for the few orders available, and tenders range over such wide limits that it is obviously impossible to make any profit out of the lowest prices offered. They often find themselves in competition with German firms which send extremely low estimates through branch establishments in the Saar. So far as iron and steel are concerned the main source of weakness lies in Belgium, where it is still found impossible for producers to arrange amongst themselves for a distribution of business and thereby prepare for a revival of the Steel Cartel. Efforts continue to be made in Belgium to force down wages, which are probably lower than in any other country, and the partial resumption this week of the recent disastrous miners' strike is believed to indicate a reaction against a wage reduction movement which has been carried too far.

Commercial Agreements.

The Ottawa Conference is generally regarded as tending in the direction of providing facilities for international trade, and manufacturers in this country are watching it closely with the certainty that it will be the prelude to a treaty of commerce between Great Britain and France, with an extension to all other countries. The Conference offers the only promise of a trade revival. It might be supposed that, as all attempts to bolster trade with economic restrictions have broken down, the country would be ready to offer as much as other nations will give it, and this is the feeling of all commercial classes which favour a lowering of tariff barriers and a fair method of commercial exchanges. The manufacturing industries, however, fear that their interests, which are not always identical with the national interest, will suffer from a too liberal interpretation of trade facilities. They are asking for higher import duties. The negotiations for a treaty of commerce are, therefore, not likely to be carried through without prolonged discussion and keen bargaining, but the importance of international exchanges in the national interest has been so strongly impressed upon the country that some fair and equitable arrangement must be reached. The returns of foreign trade during the first six months of the year show that the total exchanges declined by 36 per cent. as compared with the first half of 1931. Imports to the value of 15,278 million francs declined by 7920 million francs, and exports valued at 10,084 million francs dropped by 6139 million francs. To this last decline manufactured goods contributed 3952 million francs. These figures appeal more eloquently than anything else in favour of trade agreements.

Naval Construction.

The partial suspension of the shipbuilding programme for reasons of economy is regarded as a disagreeable necessity. It does not, however, imply that the programme has been abandoned, for the French refuse to admit that a country with a long coast line and a big Colonial Empire to protect can dispense with a navy of a power that they alone are able to estimate. They also decline to accept the principle that naval expenditure is unproductive. Their ideas are being forcibly expressed by Monsieur Emmanuel Rousseau, President of the Association Technique Maritime et Aeronautique, and by Monsieur Vergé, General Secretary of the Chambre Syndicale des Constructions Navales, who point to the necessity of keeping the shipyards in a state of efficiency. The yards are doing nothing, and a discharge of skilled workmen and a reduction of the technical staff are placing the shipbuilding industry in a very precarious situation. It is argued that expenditure on the navy is a national investment, since the construction of ships provides employment in a large number of industries and the money spent circulates in the country. When the shipyards build for the navy they are in a position to secure foreign orders, without which there can be no general activity in the French shipbuilding industry. Shipbuilders depend entirely upon the Government to get them out of their present condition of complete stagnation.

Road Traffic Restrictions.

In their desire to secure preference for the carriage of light goods, owners of motor vans and lorries have been accelerating their services in a way to endanger public safety, and vehicles are run between distant towns day and night with, it is complained, a complete disregard for ordinary traffic regulations. The Government has found it necessary to prepare new regulations affecting lorries and public service vehicles whereby a speed limit will be fixed that may relieve the pressure of road competition for goods and passenger traffic. Heavy lorries on solid tires must not exceed 15½ miles an hour and light vehicles 21¾ miles an hour. With pneumatic tires the maximum speeds will be 28 and 40 miles an hour respectively, and all vehicles having a total width of 8·2ft. or more must not travel at above 31 miles an hour. Restrictions will also be imposed on lorries with trailers.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

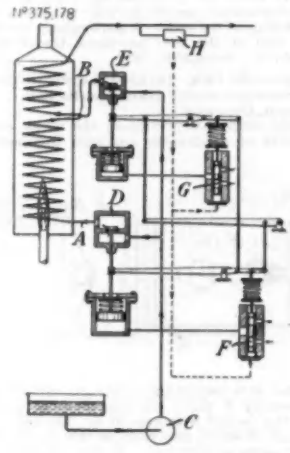
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

STEAM GENERATORS.

375,178. October 27th, 1931.—WATER-TUBE BOILERS, Sulzer Freres Société Anonyme, Winterthur, Switzerland.

In this coil boiler superheated steam is produced from the feed water supplied at A and additional water is fed in at B to regulate the amount of the superheat. C is the feed pump. The feeds are controlled by the valves D and E, which are operated by the servomotors F and G. These servomotors are controlled by the device H, which is responsive to the temperature of the outgoing steam. The linkage which connects the two servo-

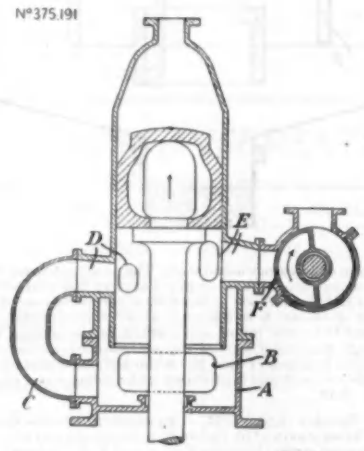


motors together is such that a change in the temperature of the steam causes adjustment of the quantity of water supplied to the tube, first by adjusting the device for regulating the additional supply, whereupon a regulating impulse is transmitted to the device for regulating the main supply, the device for regulating the additional supply being then automatically readjusted so that the quantity of additional water supplied is restored to the normal or mean value, the supply of additional water thus remaining uninterrupted.—*June 23rd*, 1932.

INTERNAL COMBUSTION ENGINES.

375,191. November 20th, 1931.—TWO-STROKE INTERNAL COMBUSTION ENGINE, Scott's Shipbuilding and Engineering Company, Ltd., Greenock, and A. Rennie, 63, Eldon-street, Greenock.

In this engine scavenging air is continuously supplied to the casing A through the port B. The air passes by the pipe C

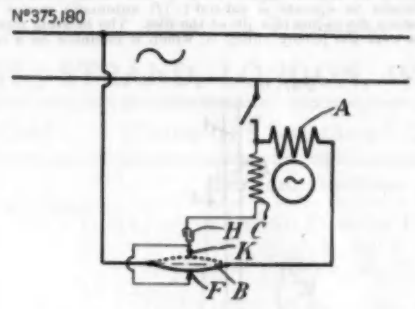


to the scavenging ports D. The exhaust ports E are slightly higher and longer than the scavenging ports. There is also a rotary exhaust valve F, which closes the exhaust as soon as the piston has covered the scavenging ports on the upward stroke. The result is that a supercharge of air is entrapped in the compression space, while the scavenging air cannot blow straight through to the exhaust.—*June 23rd*, 1932.

DYNAMOS AND MOTORS.

375,180. October 28th, 1931.—ALTERNATING-CURRENT DYNAMO-ELECTRIC MACHINES, Robert Bosch Aktiengesellschaft, of 4, Militärstrasse, Stuttgart, Germany.

In accordance with this invention, after starting, the auxiliary winding of a single-phase motor is cut out by means of a thermal switch. In the circuit of the main phase A, a thermal switch B is traversed by the main current. The auxiliary phase C is inserted in parallel to the main phase A by a contact F touched by the thermal switch when in a cold condition (as shown in the full lines). H is a condenser which produces the phase displacement in the auxiliary phase. When the motor is switched on the thermal switch B, which is traversed by the current of the main phase A, gradually heats up, and after a time moves away from the contact F, so that the auxiliary phase C is completely cut out, and only the main phase A receives current (as shown in the chain dotted lines). Should the motor be overloaded, the current flowing through the thermal switch increases and causes the thermal element to assume a still greater alteration in form, so that it finally touches a contact K, which is

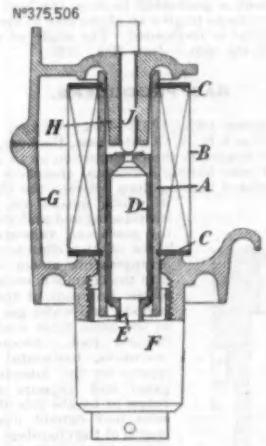


connected with the contact F. By touching the contact K the auxiliary phase C is again cut in and the turning moment of the motor increased.—*June 23rd*, 1932.

SWITCHGEAR.

375,506. May 23rd, 1931.—ELECTRIC CIRCUIT BREAKERS, George Ellison, of Wellhead-lane Works, Perry Barr, Birmingham, and George Ellison, Ltd., of the same address.

This invention relates to electric circuit breakers of the type in which the operation of a catch or other device is effected by the plunger of a solenoid, and the object is to provide a solenoid of improved construction. A is a smooth-bored tube. The length of the tube exceeds that of the winding B, so that the tube can extend beyond one or each end of the winding. The winding is held in position between end discs C which engage

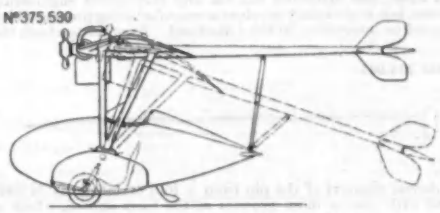


recesses in the outside of the tube. Within the tube there is a hollow plunger D. The plunger is attached at one end to the piston-rod E of a dashpot F, and the projecting end of the tube passes through an aperture in the lower side of the iron case G of the solenoid into the upper end of the dashpot cylinder, so that the tube serves both to guide the plunger and centralise the solenoid with respect to the dashpot. A boss H on the upper part of the iron case serves both to guide a stem J by which motion is imparted from the plunger to the catch or other part to be actuated, and to centralise the solenoid.—*June 30th*, 1932.

AERONAUTICS.

375,530. June 10th, 1931.—AEROPLANES, J. K. Crowe, Verulam Lodge, Brough, E. Yorkshire.

In this aeroplane the wings and tail form a unit which is hinged to the fuselage. In making the run to take off (that is, to become air borne) the machine adopts the attitude shown by full lines in the drawing, and therein accelerates till an appropriate speed is attained, on which the elevator is raised, causing the lifting surface assembly to rotate about the axis until the wing has adopted an attitude to the relative wind at which the necessary lift is developed, as shown by broken lines. It will be noted that during the run to take off the aircraft as a whole has maintained the attitude of minimum aerodynamic resistance. During flight the fuselage or its equivalent may be trimmed so as to present a



minimum of resistance to the aerodynamic forces, or alternatively may be trimmed (for the convenience of passengers or the like) so as to maintain its longitudinal axis in a horizontal plane. This trim may be maintained throughout the range of normal flying angles of the wing. In alighting, the attitude of the machine will normally be similar to that described at the moment of taking off. It is to be observed that the invention enables full use to be made of the increase in lift coefficient obtainable in wings fitted with Handley Page slots or other devices for delaying the stall, in that the machine can land with the wing at such large angles of attack as could not otherwise be obtained without the use of an impracticably large undercarriage, and without discomfort to the passengers and pilot.—*June 30th*, 1932.

CRANES AND CONVEYORS.

375,711. December 24th, 1931.—LOAD INDICATORS FOR CRANES, Sir William Arrol and Co., Ltd., and R. G. Shepherd, 92, Rigby-street, Parkhead, Glasgow.

This invention possesses the following features:—(*a*) Means

for preventing an overload being hoisted; (*b*) means for preventing over-derricking a load; (*c*) means providing an indication of a safe load; (*d*) means providing an audible signal when a load being hoisted is insufficient to operate a cut-out; (*e*) means providing an audible signal when a load being derricked is insufficient to operate a cut-out; (*f*) automatic means for indicating the radius of a jib or the like. The hoisting rope A passes over the jockey pulley B, which is mounted on a bell-

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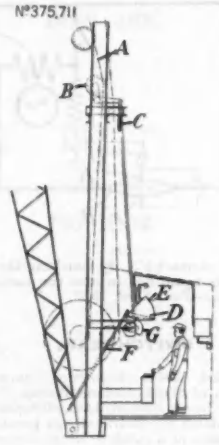
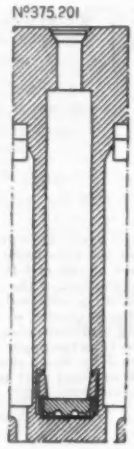


crank and is held by the spring C. The bell-crank is also connected with the pointer D on a quadrant E. The quadrant in turn is connected with the jib by the rod F and cam G. The result is that there is a relative movement of the pointer and quadrant, which is determined by the load and the angle of the jib. The quadrant is graduated to show the load and is fitted with electrical contacts to give an alarm and to open the circuit breaker if the crane is overloaded. The angle or radius of the jib is read off on the cam.—*June 30th*, 1932.

GAS PRODUCERS.

375,201. December 10th, 1931.—COKE OVENS, Dr. C. Otto and Comp G.m.b.H., 9, Christstrasse, Bochum, Germany.

The invention relates to the construction of an oven for producing gas and coke having horizontal chambers and rows of periodically operated heating flues between the chambers, and in which means are provided for introducing and uniformly distributing gases and vapours in the contents of the chambers. By these arrangements steam is introduced into the chamber, more particularly in the last part of the carbonising periods, and water gas is produced, at the same time cooling the carbonised fuel. According to the invention, horizontal distributing spaces for the introduction of the gases and vapours are arranged below or by the side of the chamber soles and extend over the whole length of the chamber. These spaces communicate with the chamber by vertical channels in the courses of the brickwork which open into the chambers by inclined downwardly directed nozzles. In the construction according to the invention, the distributing spaces are disposed in the bricks forming the soles of the chamber. These are not rigidly bonded, but projections engage in recesses of the brickwork, the joints being filled with a non-binding material—for example, silver sand. It is known that hot steam attacks the refractory bricks so that they gradually crumble in the neighbourhood of the channels. Fire-clay bricks are more resistant to the attacks of the steam, and it is advisable to form the soles of the chambers of fire-clay bricks containing the channels for introducing and distributing the gases, the brickwork courses consisting in the usual manner of a silica material.—*June 23rd*, 1932.



MISCELLANEOUS.

375,085. July 1st, 1931.—PINS, J. W. G. Saunders, the Kee-Pin Company, Ltd., 10, National-buildings, Fort-street, Auckland, New Zealand.

In itself, this invention has not any very direct engineering interest, but it obviously involves a manufacturing process which it would be interesting to have disclosed. In order to check the

No 375,085

accidental removal of the pin from a fold of fabric, it is provided with one or more grooves of the form shown, which is characterised by the fact that it has an easy entrance angle, a steeper angle to check retraction, and a rounded shoulder. It will be noted the point of the pin, as shown, is not of the orthodox ovoid form.—*June 23rd*, 1932.

375,638. September 30th, 1931.—ELECTRIC HEATERS FOR THE CONTINUOUS HEATING OF WIRES, &c., The General Electric Company, Ltd., of Magnet House, Kingsway, London, W.C. 2.

This invention relates more particularly to electric tubular heaters such as are used for raising wires of refractory metal rapidly to a high temperature by continuously passing the wire through the heater. The heater shown in Fig. 1 consists of a conical tube A uniformly diminishing from the left towards the right-hand end, and through the cylindrical or prismatic longitudinal conduit B a wire C is passed. The right-hand end of the heater, which is heated by the passage of current, has a cylindrical or prismatic thickening D which makes it possible to support the heater without the temperature gradient from the left thicker end to the thinnest part E of the tube being altered. The wire which is passed through may be heated with a rise in temperature of varying degree according to the length of the tube and the chosen thickness of the wall. For instance, if the heater is made of tungsten, a tungsten wire or sintered tungsten rod that is carried through may easily be heated from 800 deg. Cent. to about 3000 deg. Cent. The heater shown in Fig. 2 consists of a current-carrying tube A which is diminished step by step over its whole length from left to right. This tube is also provided with a cylindrical or prismatic longitudinal passage and a thickened end part D serving for the supporting

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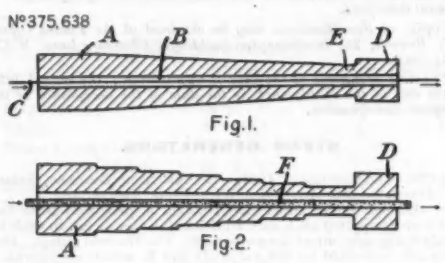

of the tube, and next to this thickened part is the thinnest part, which also becomes the hottest upon the passage of current through the tube. In this case sintered rods F of tungsten or other refractory metal are propelled by hand or mechanically through the longitudinal conduit in order to obtain a uniformly increasing sintering of the rods. A particularly good texture of sintered rods and of the wire produced therefrom can thus easily be obtained.—*June 30th*, 1932.

375,188. November 13th, 1931.—ELECTRICAL CONDENSERS, Siemens-Schuckertwerke Aktiengesellschaft, of Berlin-Siemensstadt, Germany.

In accordance with this invention, the metal foils and dielectric elements of condensers are held together by metal

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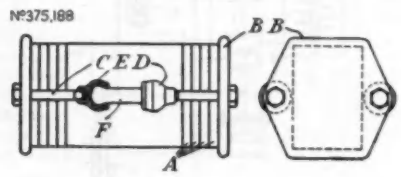

clamps provided with insulating couplings. On the ends of the condenser assembly A there are iron pressure plates B with through bolts C provided with caps D E. The cap D surrounds a porcelain body F which also seats in the cap E. The cap D may consist of metal or porcelain. In the latter case, it may be integral with the porcelain body F.—*June 23rd*, 1932.

375,447. March 31st, 1931.—METAL VAPOUR ARC RECTIFIERS AND LIKE APPARATUS, *International General Electric Company, Incorporated, of* 120, *Broadway, New York, U.S.A.*

According to this invention the potential difference existing between the coolers and container or the cathode of a rectifier is utilised to charge a storage battery during operation, and the battery is used as the source of current for the ignition arc with the coolers as anodes. The battery may also be employed for

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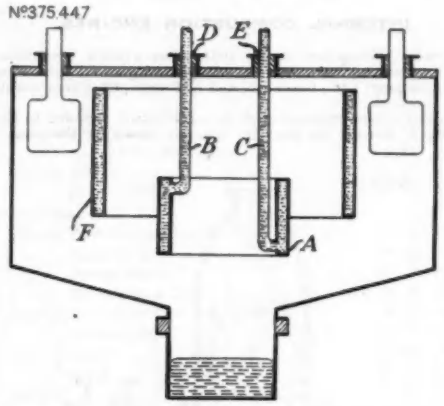

the operation of accessory apparatus. The positive tension of the insulated coolers is used for charging a battery disposed between the coolers and the cathode or the wall of the container. In the illustration a cooler A is disposed above the cathode. The pipes B and C for the inflow and outflow of the cooling water pass through the metal wall of the container by means of the vacuum-tight insulators D and E. A similarly insulated cooler F encircles the cooler A and is provided with cooling water pipes.—*June 30th*, 1932.

375,724. January 21st, 1932.—CLEANING SURFACES COATED WITH LUBRICATING OIL SLUDGE, A. Duckham and Co., Ltd., 16, Cannon-street, London, E.C. 4, and S. E. Bowrey.

The invention relates to a method of cleaning surfaces which have become coated with lubricating oil sludge, such as parts of the oil coolers comprised in forced lubrication systems. It is found, the inventors say, that during use lubricating oil forms insoluble, adherent solids which diminish the efficiency of coolers by coating the cooling surface. Coolers in this condition are sometimes treated with kerosene, creosote and other solvents, but difficulty is experienced in thoroughly removing the sludge. According to the present invention, the surfaces to be cleaned are treated with phenol, cresol, or other phenols obtainable from coal tar, in particular commercial carbolic acid. These substances need not necessarily be employed at full strength, but may be diluted with tar distillates, petroleum distillates, or other suitable diluents. It is found, however, that in order to secure satisfactory results the liquid should contain not less than 25 per cent. of phenolic substance. The cleaning operation is carried out as follows:—The oil supply and discharge pipes are disconnected from the cooler and a steam supply pipe connected to any convenient point near the bottom of the oil space. A vent near the top is left open and all other connections to the oil space are blanked off. The oil space is about half-filled with commercial carbolic acid and steam injected for about two hours in sufficient volume to throw the carbolic acid over the whole of the nest of tubes. The carbolic acid is next drained off and the cooler rinsed with dilute alkali, then with water and ventilated until dry. The inventors do not confine themselves to this or any other method of applying the cleansing medium, but describe the procedure purely by way of illustration.—*June 30th*, 1932.

375,528. June 9th, 1931.—DUST REMOVAL FROM BUFFING AND GRINDING WHEELS, P. J. Ségui, 197, Avenue Gambetta, Paris, France.

This dust collecting hood for buffing and grinding wheels is characterised by the fact that it includes a number of separate ducts. It is essential that each of the two walls of each duct

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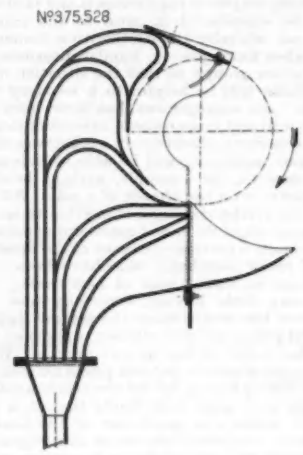

inlet be directed tangentially to the rotary member and that the front wall of one duct coincide for a distance with the rear wall of the preceding duct. This feature is absolutely necessary to ensure normal operation of the device. It is claimed that the draught produced by the wheel itself is sufficient to carry away the dust.—*June 30th*, 1932.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Tuesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

SATURDAY, AUGUST 20TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—North Wales District meeting at Penmaenmawr. Meet at Penmaenbach works, Penmaenmawr. 2.15 p.m.

WEDNESDAY, AUGUST 31ST, TO WEDNESDAY, SEPTEMBER 7TH.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.—Annual meeting at York. President, Sir J. Alfred Ewing, F.R.S. Particulars may be obtained on application to the secretary, British Association, or to the hon. local secretaries, British Association, The Guildhall, York.

SATURDAY, SEPTEMBER 24TH.

ALL-BRITISH EXHIBITION.—Copenhagen, Denmark. Opening.

LAUNCHES AND TRIAL TRIPS.

TRONDANGER, single-screw motor ship; built by the Netherland Shipbuilding Company; to the order of Messrs. Westfal-Larsen and Co. A/S., Bergen, Norway; dimensions, 486ft. by 61ft. by 39ft. 6in.; to carry cargo and a few passengers. Oil engines, constructed by A.E.G., Berlin; launch, July 2nd.

BHADRAVATI, single-screw steamer; built by Harland and Wolff, Ltd.; to the order of Bombay Steam Navigation Company, Ltd.; dimensions, 230ft. by 38ft. 6in. by 23ft. 3in.; to carry cargo and passengers. Engines, triple-expansion; constructed by the builders; launch, July 5th.

SOUTHERN CROSS VI., twin-screw motor vessel; built by J. Samuel White and Co., Ltd., for the Melanesian Mission Trust (England), Ltd.; dimensions, 106ft. by 25ft. by 11ft. 9in.; for the Bishop of Melanesia's Pacific Islands work. Oil engines, two-stroke, cold-starting type; constructed by L. Gardner and Sons, Ltd.; launch, June 22nd; trial trip, July 7th; dedicated by the Archbishop of Canterbury, Tuesday, July 26th.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

WILLIAM FIRTH AND CO., iron and steel, and machinery merchants, inform us that from August 1st, 1932, their address will be 8, Hillary-place, Leeds.

THE HENRY WELLS OIL COMPANY, Ltd., informs us that as from July 18th, 1932, the name of the company has been changed to Germ Lubricants, Ltd. There has been no alteration in management or policy.

THE SELSON MACHINE TOOL COMPANY, Ltd., 23, Abbey House, Victoria-street, London, S.W. 1, has concluded arrangements with John Lund, Ltd., of Keighley, Yorks., to represent that firm in the South and the Midlands of England, as well as for export.

THE NEWBURY DIESEL COMPANY, Ltd., King's-road, Newbury, England, advises us that it has purchased the works, drawings, and jigs of the Plenty-Still Oil Engines, Ltd. It is the company's intention to continue with the manufacture and supply of "Plenty-Still" engines, whilst embodying in their design such improvements as are considered advisable.

G.W.B. ELECTRIC FURNACES, Ltd., and Wild-Barfield Electric Furnaces, Ltd., have entered into a working arrangement with Industrie-Elektroofen G.m.b.H., Cologne, whereby the two first-named firms will manufacture and sell in Great Britain electric furnaces constructed under the Russ patents.